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Triangulating Translation

EDITED BY Fabio Alves

Triangulating Translation

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Volume 45

Triangulating Translation: Perspectives in process oriented research
Edited by Fabio Alves

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Perspectives in process oriented research

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Table of contents

III. Pedagogical applications

Foreword

Triangulation in process oriented research in translation

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The articles which appear in this volume stem from papers presented in a sub-section of the II Brazilian International Translators' Forum dedicated to process oriented research in translation. The Congress's main theme, namely Translating the Millennium: Corpora, Cognition, and Culture, is reflected in the seven contributions which aim at fostering the dialogue among translation researchers interested in process oriented investigations. Triangulating Translation highlights one of the event's main axes, focusing on the interfaces between cognition and translation, and more precisely on the investigation of translation processes from three main vantage points: theoretical perspectives, empirical investigations and pedagogical applications. The volume brings together researchers from the Copenhagen Business School (Denmark), the Universidade Autónoma de Barcelona (Spain), the Federal University of Minas Gerais, the Federal University of Rio de Janeiro, and the Federal University of Ouro Preto (Brazil).

The title of the volume, Triangulating Translation: perspectives in process oriented research, is to be understood in the light of triangulation as a sailing metaphor which guides the articles presented here. Assuming that navigating through uncharted waters requires several location points to establish one's position, and taking examples from the Social Sciences, the authors focus on the need to apply several instruments of data gathering and analysis in their attempts to throw light on the nature of the process of translation, and mainly on issues related to inferential behavior, intersubjectivity, competence, segmentation, time pressure, dictionary use, and the novice-expert interface. The seven

articles favour triangulation as a methodologically valid alternative to research on translation, and more appropriately on the process of translation.

The articles are grouped in three parts. Part I discusses theoretical perspectives in the field of study under scrutiny and raises issues concerned with the translation-pragmatics interface, the role of subjectivity – or rather, intersubjectivity – as an alternative to the objectivist paradigm in process oriented research, and the attempts at building a model to account for translation competence.

Concentrating on the translation-pragmatics interface, and more precisely on the role played by inferential processes in decision making and problem solving in translation, Fabio Alves and José Luiz Gonçalves build on the notion of interpretive resemblance and suggest that Relevance Theory (RT) can be used in the investigation of inferential processes within translation contexts. The authors discuss the distinction between conceptual and procedural encoding made by RT and argue that it can provide a theoretical framework upon which empirical investigations into the nature of inferential processes in translation can be carried out. Using extracts from TAPs and *Translog* protocols, they show how the ability to consciously manipulate conceptually and procedurally encoded information, coordinated by interpretive resemblance, leads to the inferential reorganization of the source text into a target text counterpart.

Gyde Hansen focuses her research on the evaluation phases, and especially on the interaction between the translators' skills, knowledge and competences and the translator's ability to keep process and product under control in what the American psychologist Mihaly Csikszentmihalyi calls a "flow experience". Using phenomenology as her epistemological support, Hansen makes some theoretical and methodological remarks on research in translation processes, mainly on instances of controlling that process. She advocates that if one wants to improve translation processes, it is necessary for translators to learn how to think and to express their thoughts during and after the translation process. Phenomenology with its emphasis on precise explanations and descriptions of phenomena and its efforts through negotiation to reach clarification and intersubjectivity may offer researchers the tools to facilitate this process.

The PACTE Group, formed by Allison Beeby, Monica Fernández Rodríguez, Olivia Fox, Amparo Hurtado, Wilhelm Neunzig, Mariana Orozco, Marisa Presas, Patricia Rodríguez Inés and Lupe Romero, reinforces in this volume the proposal of building a translation competence model. By investigating translation competence from two complementary points of view, namely the translation process and the translation product, and using different instruments and different types of data-collecting methods so that the data can

be collated and cross-referenced, PACTE members consider here other as-
pects of the analysis of expert translation competence, including the psycho-
physiological components, and the position in the model of knowledge about
translation, and introduce a Translation Competence Model that has been
validated empirically.

Part II focuses on empirical-experimental investigations and aims at exam-
ining the process of translation in terms of relevant measurements which can
validate some of the instruments used in the triangulation approach.

Using the *Translog* software to generate data from computer keystrokes,
logging them in real time, Arnt Lykke Jakobsen designed a study to measure
the effect of thinking-aloud on translation speed, the amount of revision un-
dertaken, and the amount of processing segmentation, both in a group of
semi-professionals and in a group of experts. Reviewing the seminal work by
Ericsson & Simon, his article reveals that the think-aloud condition signif-
icantly reduced translation speed, had no effect or an indeterminable effect
on the amount of revision undertaken, and significantly increased the relative
number of segments per source text unit, thus clearly redefining the application
of the TAP technique to the investigations of the translation process.

Further on, Rui Rothe-Neves reports on the influence of working memory
(WM) features on some formal aspects of translation performance. For this, he
investigates the relationships between WM and translation performance, and
more precisely, what measures should be taken and which hypotheses could
be considered regarding the relationship between the many ways of measuring
processing speed, task coordination and storage capacity as features of WM
and translation performance by novices and experts, all of them considered in
relation to process and product. In short, Rothe-Neves claims that translation
performance does not imply acquiring a completely new ability, but rather
organizing a better, more efficient, and resource-saving way of approaching
the translation task.

Finally, the articles in Part III foster the application of triangulation as a
pedagogical instrument to be applied to the education of translators.

Moving into students' territory, Inge Livbjerg and Inger Mees discuss
the results of three experiments at the Copenhagen Business School (CBS)
aimed at comparing translation into the foreign language carried out with or
without access to dictionaries. Analyzing patterns of dictionary use in non
domain-specific translation, the two authors investigate how, and to what
extent, students use dictionaries when translating non domain-specific texts
and whether the use of dictionaries influenced the quality of the translation
product. They claim that by letting students translate texts under conditions

similar to those of their experiments, and then proceeding to discuss their translation behavior and strategies with them, translation teachers can give valuable advice to individual students, with a focus on their specific needs.

Closing the volume, Heloisa Barbosa and Aurora Neiva advocate the use of two modalities of think-aloud protocols to investigate the translation process of inexperienced and experienced translators. The researchers claim that a combination of monologue and dialogue versions of TAPs appears to outweigh potential drawbacks of the TAP technique, thus allowing for triangulation to be carried out. Considering the insights obtained by means of comparisons made between verbal protocols from different research subjects, with different language skill levels and different backgrounds in translation practice itself, Barbosa and Neiva suggest that it may be possible to acquire information that can be helpful in the education of future translators.

Highlighting the cognition-translation interface, the seven articles in this volume form a concise body of knowledge that promotes the integration of theoretical, methodological and pedagogical perspectives linked by the sailing metaphor of triangulation and, thus, give impetus to the debate of how research within the process oriented approach is to be carried out. Embracing the II Brazilian International Translators' Forum's main theme, Translating the Millennium: Corpora, Cognition, and Culture, Triangulating Translation suggests in the advent of the millennium new research avenues, offering uncharted possibilities to explore the complexity of cognitive processes in contexts of translation. A research endeavour certainly worth being further pursued.

Theoretical perspectives

A Relevance Theory approach
to the investigation of inferential processes
in translation

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This article uses the theoretical framework proposed by Relevance Theory (Sperber & Wilson 1986/95) and advocates a competence-oriented research of translation – CORT – (Gutt 2000a) to investigate characteristics of problem solving and decision making processes in translation. For this purpose, it builds on the notion of triangulation (Jakobsen 1999) and attempts to locate, by means of the concurrent use of different data elicitation procedures, i.e. *Translog* and retrospective protocols, inferential patterns related to subject's performance. By cross-examining the translation works of four novice translators from English into Portuguese, it deals with inferential issues related to the conscious-unconscious manipulation of conceptual and procedural encodings and discusses their role in the unfolding of translation processes. By way of conclusion, it shows that a relevance-theoretic view of translation processes may be able to account for how implicatures and explicatures are expressed in different cognitive environments and, therefore, in different target texts.

Introduction

The general problem we are dealing with in this article can be expressed as follows: what are the basic characteristics of problem solving and decision making processes in translation? We believe that this question is central to process oriented studies in translation and, as such, it has been the object of a recurrent debate among translation scholars, and even more so among researchers interested in the inferential nature of the translation process (Alves 1995, 1996, 2001a; Gutt 2000a, 2000b). Building on Relevance Theory (Sperber & Wilson 1986/95), we favour an approach that advocates a competence-

oriented research of translation – CORT – (Gutt 2000a: 205) and embed it within the scope of scientific investigations that focus on the competence of human beings to communicate with each other. According to Gutt:

> The aim of CORT is to understand and explicate the mental faculties that enable human beings to translate in the sense of expressing in one language what has been expressed in another. The idea is that once these faculties are understood, it is possible to understand not only the relation between input and output, but also, and perhaps more importantly, the communicative effects they have on the audience. After all, the *raison d'être* of all translation appears to be to *communicate*. (Gutt 2000a: 206)

Bearing this in mind, we also build on the concept of translation competence proposed by Alves, Magalhães & Pagano (2000) for issues related to pedagogical and didactic applications. They state that translation competence implies "all the knowledge, abilities and strategies a successful translator masters and which lead to an adequate performance of translation tasks" (Alves, Magalhães & Pagano 2000: 13). This point of view is corroborated by Keen's (1988) notion of general competence, who states that competence means being able to do something, which, of course, involves a lot of knowledge, abilities and strategies as well. Based on the CORT framework, we expand the view suggested in Gonçalves (1998) – namely, that translation competence is mostly based upon strictly linguistic and pragmatic competences – and consider translation competence as the sum of several sub-competences which are constituents of a complex cognitive network of knowledge, abilities and strategies (see PACTE, this volume), and, which, in turn, are all processes of an ever-changing biological being structurally coupled with a social/cultural environment (Maturana 2001). In other words, we attempt to take a more contextually and inferentially grounded approach to translation and translator's competence. In this regard, we define context here in two ways, both derived from the Relevance Theory framework: a broad individual inferential context, which also encompasses a mutual context. This latter context, namely the mutual manifestness, can be regarded as the interlocutors' respective portions of individual contexts that optimally match in a certain communicative exchange. This two-fold conception of context explains how communicative processes can be more or less successful depending on the degree of intersection between the individual contexts: the greater the intersection, i.e. the degree of mutual manifestness, the higher the probability of successful, effective communication. Besides, the way each individual carries out inferential processes depends on the context that will emerge from his/her cognitive environment in response to certain socio-

interactive conditions. Thus, while any context takes place on individual, internal and momentary bases, i.e. as the emergence of a set of mental representations during inferential processing, it is also expected to be strongly dependent on the individual's socio-interaction history, which along with other types of stimuli will contribute to the construction of his/her cognitive environment. Thus, we move away from the dichotomy between the code model (Shannon & Weaver 1949) and the inferential model (Grice 1975) to attempt to explain the nature of human communication and, building on Relevance Theory, propose an analysis which amalgamates encoding and inferential processes as complementary parts of the human cognitive structure and, therefore, appropriate to account for macro and micro decision making processes in translation.

For instances of translation, we believe that the notion of interpretive resemblance (Gutt 2000a) offers an insightful alternative – both theoretical and empirical – to account for problem solving and decision making processes in translation for it presupposes that "any instance of human (ostensive) communication necessarily involves an element of inferential interpretation" (Gutt 2000b: 166). We also draw on the distinction between conceptual and procedural encoding (Blakemore 1987; Blass 1990; Wilson & Sperber 1993) and argue that it can provide a theoretical framework upon which empirical investigations on the nature of the translation process can be carried out. In short, we argue that the ability to manipulate consciously, in both L1 and L2, conceptually and procedurally encoded information, coordinated by interpretive resemblance, leads to the reorganization of the explicatures and implicatures conveyed by the source text into a target text counterpart (Alves 2000).

As a final introductory remark, it is important to note that this article adopts the notion of intersubjectivity (see Hansen, this volume) as an instance of ecological validity for research within the competence oriented paradigm. This notion is congruent with the need to reconsider scientific objectivity as suggested by Maturana (2001), who states that the way we produce and validate knowledge should not be supported only by logical and formal principles, normally embraced by the orthodox branches of science, but mainly by criteria of biological plausibility. Thus, we build on the notion of triangulation, borrowed from the Social Sciences (see Alves 2001b; Jakobsen 1999), to attempt to locate, by means of the concurrent use of different data elicitation procedures, i.e. *Translog* and retrospective protocols, inferential patterns related to translation performance. For that we cross-examine and analyse the work of four novice translators from English into Portuguese and deal with inferential

issues related to the conscious-unconscious manipulation of conceptual and procedural encodings in their translations.

Theoretical considerations

According to Relevance Theory (henceforth, RT), the processing of utterances by an individual in a communicative situation will generate some changes in his/her cognitive environment that will result either in the production of new assumptions or in the reinforcement or weakening of old ones; those assumptions are to be considered as the mental representations of actual or possible states of affairs in a real or imaginary world that an individual stores in his/her mind. In the logical apparatus used by RT, the role of cognition and learning becomes very powerful, once the processing of utterances in communication and the reprocessing of internal assumptions are always modifying the organization of the individual's cognitive environment. This view challenges those approaches to language and cognition which normally understand language processing as a unidirectional and standardized process generating equal products and see the human mind as a stable entity (see Chomsky 1965, 1980; Fodor 1983).

By introducing the principle of Relevance as an alternative to Grice's Cooperative principle (Grice 1975), RT brings plasticity and flexibility into the explanation of cognitive and inferential processes. Replacing the Gricean concepts of mutual cooperation and mutual knowledge by those of mutual manifestness and cognitive environment respectively, and postulating the existence of variable emerging contexts regulated by given relevance in the place of variable degrees of relevance in a given context, RT introduces a notion of context established *online* in opposition to traditional views of context as established *a priori*. Therefore, the RT framework brings us a plausible account of the notion of context as it takes into account individual differences among interlocutors, thereby explaining communication as subject to different degrees of success instead of being simply a matter of processing pieces of stable information.

In short, RT accounts for the unfolding of human inferential processes through the following sequence:

> RELEVANCE = [ostensive-inferential behaviour + (cognitive environment + mutual manifestness)] → contextual effect   (Alves 2001a: 18)

According to RT, human cognitive processes are geared to the maximisation of relevance. This process is supported by the principle of relevance

which accounts for the production of contextual effects. Directed by ostensive-inferential behaviour and regulated by instances of mutual manifestness and embedded in rather flexible cognitive environments, human inferential processes aim at achieving the strongest possible contextual effects at the expense of the least possible cognitive effort.

Therefore, based on Gutt (2000a) and his applications of RT to Translation Studies, our current views on translation include

– Translation as an act of communication;
– Translation as an information processing activity;
– Translation as an instance of cognitive categorisation;
– Translation as an instance of pragmatic contextualisation;
– Translation as a problem solving and decision making activity.

It is a given fact that translation can be investigated from several perspectives. Studies may focus on linguistic, discursive, cultural, social, political, and other aspects. However, RT brings forward a cognitive core which appears to be central to all human communication efforts, and, we believe, it is this common cognitive core that makes human communication across language and cultural boundaries possible. As Gutt states

> In my view, the most significant contribution of relevance theory is that it provides a new cause-effect framework for understanding this cognitive core area. Note that the cause-effect notion here is mental rather than socio-cultural, which makes it different from the cause-effect relations investigated by Chesterman (1997), for example.   (Gutt 2000b: 163)

We believe that this change in perspective offered by RT has radical implications for the study of human inferential processes, and, as a consequence, for process oriented studies in translation.

So, based on the cause-effect interdependence in communication, Gutt suggests that one makes

> testable predictions about the success and failure of human communication events. Thus the cause-effect relation predicts communication problems when the audience lacks ready access to certain pieces of information which are needed for consistency with the principle of relevance.   (Gutt 2000b: 164)

In order to accomplish this purpose, we will focus in this article on the concepts of procedural and conceptual encoding (Blakemore 1988; Blass 1990; Moeschler 1998; Wilson & Sperber 1993), as well as on the notion of interpretive resemblance proposed by Gutt (2000a) for instances of translation.

According to RT, conceptually encoded information conveys conceptual meaning and is propositionally extendable. It can be enriched and contributes to the inferential processing of an utterance. Conceptual information is, therefore, encoded by open lexical categories, such as nouns, adjectives and verbs.

Procedurally encoded information, on the other hand, cannot be extended in propositional terms, but contributes decisively to the cognitive processing of an utterance by imposing inferential constraints on it. In linguistic terms, procedural information is encoded via non-open morphological categories, such as negation, tenses, determiners, word order, etc.

Moeschler gives a very clear picture of the distinction between procedural and conceptual encoding as he focuses on some directional inferences related to discourse relations. In the examples below, both utterances convey the same propositional forms by almost the same conceptual encoding although the inversion of sentences in the second example implies a procedural encoding move in terms of discourse relations.

(1)   Max pushed John. John fell.   Narration
(2)   John fell. Max (had) pushed him.   Explanation

Moescheler (1998:4)

Gutt (2000b:175) points out that "the work of Blakemore, Blass and others has shown that elements of language can encode 'processing instructions' which provide guidance to the audience as to how an expression is intended to be relevant". It is exactly this point that we aim at investigating further for instances of translation. We argue that besides the mastery of many other cognitive skills, translators have to learn to manipulate more consciously conceptually and procedurally encoded information so that they can identify the inferential constraints inherent to a given statement. By means of this manipulation, it becomes possible for them to extend it inferentially in order to meet the demands of the target audience and its context. In this case, translators are supposed to maximise the mutual manifestness between themselves and the target audience in order to enhance the probability of successful communication in translation.

Additionally, given that the translator's activities centre on interpretation – in the technical relevance-theoretic sense – the notion of interpretive resemblance also needs to be considered. As Gutt states

> Considering further that the main purpose of utterances is to convey the set of assumptions which the communicator intends to convey, it seems reasonable to define interpretive resemblance between utterances in terms of assumptions shared between the intended interpretations of these utterances. Since the set

of assumptions an utterance is intended to convey consists of explicatures and/or implicatures, we can say that two utterances, or even more generally, two ostensive stimuli, interpretively resemble each other to the extent that they share their explicatures and/or implicatures. (Gutt 2000a: 44)

Drawing on Gutt, we propose to analyse instances of translation in which some of the required contextual information may be absent or artificially present and see whether or not the predicted problems arise. This is a very important point for it is not the linguistic properties as such that are to be identified and preserved. Rather, translators should search for communicative clues, which are abstractions from the actual linguistic properties of the text and may need to be provided by very different linguistic means in the receptor language.

For Gutt

'Communicative clues' can be identified only by reference to the role they play in guiding the audience towards the intended interpretation, not by straightforward structural or text-linguistic comparisons. Hence their discovery cannot be separated from the process of finding the intended interpretation of the original, consistent with the principle of relevance. (Gutt 2000b: 169–170)

It is exactly this last point, i.e., the process of finding the intended interpretation of the original, consistent with the principle of relevance, that we aim to investigate here. We propose to examine how conceptually and procedurally encoded information in a given source text may be intersubjectively processed. Consequently, within a relevance-theoretic framework, we try to account for the production of target texts and to what extent they interpretively resemble the original.

Research design and methodological considerations

While considering research perspectives based on CORT, Gutt points out that there are quite challenging questions for research.

Assuming that we normally have 'natural' intuitions with regard to relevance, what happens in our minds when we are dealing, not with our 'naturally' existing context, but with an 'artificial' one? Can we somehow immerse ourselves in that context and then still proceed intuitively? Or do we perhaps work 'reflectively' or 'analytically' rather than intuitively. Is there a difference, and if so, what is it? (Gutt 2000b: 169)

This is precisely the point which we aim at highlighting here. Four novice translators were chosen to take part in a small experiment. They were selected

on the basis of similar profiles, i.e., similar proficiency levels in both L1 and L2, some formal training on translation practice and no professional experience whatsoever.

Subjects were asked to translate a short extract taken from the news magazine Newsweek, entitled "The Wear and Tear of Terror", published in the November 27, 2001 issue and reproduced below:

> THE WEAR AND TEAR OF TERROR
> Growing up in Saudi Arabia, the young Osama bin Laden (top) was a pampered child of luxury. By 1998, the year of the U.S. Embassy bombings in Africa, he had acquired the lean, wolfish look of a revolutionary. During an interview two weeks ago, he was plumper, grayer and deathly pale, perhaps from hiding in the caves.

Subjects were provided with the 63 word text and asked to translate it into Portuguese using *Translog* (Jakobsen 1999), a computer program which records all keyboard activity, and save their target texts as a log file after completing the task. In order to create similar experimental conditions, the four subjects were asked to translate the passage in the same room and at the same time. All of them completed the task in a similar fashion with no significant differences observed among the group. The source texts were accompanied by three photographs of Osama bin Laden scanned in gif format, which portrayed him at three different time intervals, as a healthy young man, as a revolutionary leader in his prime, and as an exhausted individual after the U.S. operations in Afghanistan. These photographs were considered to be contextual builders for the purposes of the experiment.

After completing and saving their respective target texts, subjects were interviewed on an individual basis and used the *Translog* replay function to watch and comment on their own performances by means of retrospective TAPs.[1] No time constraint was imposed on this task. Their utterances were recorded on audiocassette and their audio recordings were transcribed verbatim.

The undoubtedly enormous and promising advantages of *Translog* for the study of cognitive processes in translation have been comprehensively discussed in recent publications (Jakobsen 1999; Alves 2001b). For the present study, *Translog* was used as a tool for the identification of segmentation strategies, pause intervals and, consequently, for the establishment of translation units (henceforth, TU). Drawing on Alves, Magalhães & Pagano (2000), TUs are seen here as segments of the source text, independent of specific size or form, to which, at a given moment, the translator's focus of attention is directed. It is a segment in constant transformation that changes according to

the translator's cognitive and processing needs. Thus, segmentation procedures and pause intervals registered in *Translog* will serve as indicators of procedural steps and processing profiles among subjects.

As stated above, *Translog* protocols were enriched by retrospective rather than concurrent TAPs. One main disadvantage of concurrent TAPs is that they may require subjects to spend extra cognitive effort to verbalise their thoughts while carrying out a translation task (see Jakobsen, this volume). Furthermore, one may claim that speaking while translating a written text is an artificial situation that has little to do with real translation processes. We believe that there may be good counter-arguments to these alleged limitations. Although TAPs may sometimes bring about a certain amount of cognitive overload, they are, however, a rich source of access to strategic planning and inferential processing which subjects may have implemented during a translation task. Thus, one of the main advantages of using TAPs is to gain indirect access to a great deal of strategic and inferential processing clues related to translation competence. However, considering the alleged artificiality of speaking during translating, our concern for ecological validity, and the need to arrive at instances of intersubjectivity among our subjects, we have decided to use retrospective TAPs in our investigation, and thus allow for reflections on translation of a more subjective nature.

Using retrospective TAPs and online *Translog* protocols, we have scrutinised the data to examine to what extent our four subjects showed evidence of a systematic approach to translation in their inferential processes or whether this occurred randomly on the basis of rather intuitive patterns. The hypotheses listed below will direct our analyses.

Hypotheses

Drawing on the distinction between procedural and conceptual encodings, we have formulated two hypotheses to be tested by means of relevance-theoretic assumptions.

In the light of Moeschler's arguments mentioned above, hypothesis 1 postulates that, on the basis of the degree of explicitness in a given TU, there will be fewer problems in the recognition of the procedurally encoded information in the source text and this, in turn, will yield similar inferential processing among subjects. Translation decisions will be more structurally oriented.

Along the same theoretical framework, hypothesis 2 states that, due to the level of implicitness in a given TU, conceptually encoded information will be

handled on the basis of individually available contextual assumptions. Solutions will, therefore, be inferentially supported by contextual assumptions derived from the translators' cognitive environments and vary randomly among subjects. Translation decisions will be more contextually oriented.

Discussion

Due to space constraints, we will restrict our analysis of procedural and conceptual encodings, and that of interpretive resemblance, to only one sentence in our corpus.

> (1)   By 1998, the year of the U.S. Embassy bombings in Africa, he had acquired the lean, wolfish look of a revolutionary.

There are two problems to be investigated in (1), namely:

> (1)   a.   the U.S. Embassy bombings in Africa
>   b.   the lean, wolfish look of a revolutionary

In the light of our hypotheses and to the degree of explicitness in (1a), we assume that there will be few problems in the recognition of the procedurally encoded information in the cluster "the U.S. Embassy bombings in Africa" and this will lead to the possible realisation that more than one embassy was bombed. Subjects will, therefore, attribute similar solutions to the translation of (1a). On the other hand, due to the level of implicitness in (1b), we assume that the photographs of Osama bin Laden will be used as contextual builders to support inferential processes embedded in the subjects' cognitive environments. The conceptually encoded information in the cluster "the lean, wolfish look of a revolutionary" will be handled on an individual basis and, as such, solutions to the translation of (1b) will vary randomly among subjects.

From the data gathered by *Translog* and retrospective protocols, we list the following translations for (1):[2]

> (2)   *Em 1998, o ano do bombardeio na embaixada americana na África, ele se tornou um revolucionário mais magro e mais exótico.*
> In 1998, the year of the American Embassy bombing in Africa, he became a thinner and more exotic revolutionary. (S1)

> (3)   *Em 1998, quando a embaixada americana na África sofreu atentados à bomba, ele tinha o visual magro e agressivo de um revolucionário.*

In 1998, when the American Embassy in Africa suffered bomb attacks, he had the thin and aggressive appearance of a revolutionary. (S2)

(4) *Por volta de 1998, ano em que ocorreram os bombardeios da Embaixada Americana na África, ele já tinha a aparência esbelta e selvagem de um revolucionário.*
Around 1998, year in which the bombings of the American Embassy in Africa occurred, he already had the thin and wild appearance of a revolutionary. (S3)

(5) *Em 1998, quando as embaixadas dos Estados Unidos na África foram bombardeadas, adquiriu o gosto, a face selvagem de um revolucionário.*
In 1998, when the U.S. Embassies in Africa were bombed, he acquired the taste, the wild face of a revolutionary. (S4)

Besides the many similarities in their products, it is interesting to observe how the four subjects arrived at their translations. For that, we have first analysed their individual performances and then tried to identify similarities and differences among their translation patterns. Their patterns of segmentation for the cluster "the U.S. Embassy bombings in Africa" were nearly identical, with an average of 01':03" allotted to its processing. Pauses were minimal and there was no need to look the TU up in dictionaries or to search for complementary information from other external sources. However, contrary to what had been predicted in our first hypothesis, the four subjects had difficulties in identifying the procedurally encoded information conveyed by the plural marking of the cluster "the U.S. Embassy bombings in Africa" (see Table 1).

Subject 1 failed to notice the procedurally encoded information in (1a) and, although she claimed that "it was very easy", her translation is linguistically and contextually inadequate.

(6) ✷Em◆1998✷,o◆⊠⊠◆o◆ano◆✷✷✷✷✷✷✷✷✷✷da◆⊠⊠✷✷o✷ bomba⊠⊠⊠⊠⊠⊠o◆bombardeio◆na◆embaixada◆americana◆na ◆✷Á✷frica,◆ (S1)

Table 1. TU1: The U.S. Embassy bombings in Africa

Subject	Translog Elapsed Time Span	Retrospective TAPs – Extracts
S1	01':08"	It was very easy.
S2	01':12"	… to differentiate atentados à bombas from bombardeios
S3	00:55"	No verbalization
S4	00:57"	I know that two embassies were bombed in Africa …

(7)   One unit of translation for me was "by 1998, the year of the U.S Embassy bombing in Africa". It was very easy. (S1)

Transcripts (6) and (7) above show a low degree of interpretive resemblance in the processes that gave rise to the target text in (2). On the other hand, transcripts (8) to (11) below apparently indicate that the procedurally encoded information in (1a) had been recognised and the two subjects incorporated it into their translations. However, on closer scrutiny we notice that only the explicit plural marking was taken into consideration, and no attention was paid to the fact that in the cluster "the U.S. Embassy bombings in Africa" U.S. Embassy has an adjectival role and, therefore, "bombings" could be attributed to one ore more embassies, which, in fact, corresponded to the actual scenario in Africa.

(8)   Em◆ ✶ ✶1998,◆ ✶ ✶ ✶ ✶ ✶ ✶o◆nao⊠ ⊠ ⊠ano◆que◆a◆embaixada◆ ✶americana◆na◆Africa◆ ✶ ✶ ✶sofreu◆atentados◆a◆bombo⊠a,◆ (S2)

(9)   [...] Paraphrasing was a strategy I used a lot, in this case to make it clear in Portuguese, to differentiate atentados à bomba from bombardeios [...] (S2)

(10) Por◆volta◆de◆1998,◆o◆ano◆dos◆bomb⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠◆ano◆em◆que◆ocorreram◆os◆bombardeios◆da◆ embaixada◆americana◆na◆África,◆ (S3)

(11) Well, after typing … África, it took me almost a minute to look up in the dictionary the word "lean". (S3)

It is interesting to note that, although the solutions *atentados à bomba* [bomb attacks] and *bombardeios* [bombings] process and incorporate part of the procedurally encoded information in the NP, they both fail to recognise the communicative intention of (1a) and, thus, are unable to convey an adequate interpretive resemblance between source and target texts. This is partially achieved in transcripts (12) and (13) below when the subject assigns the bombings to more than one embassy.

(12) ◆Em◆1998,◆ ✶quando◆as◆embaixadas◆dos◆estados◆Unidos◆na◆ Africa◆foram◆atacadas⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠dombardeadas←←← ←←←←←←⊠b⇨,◆(S4)

(13) I know that two embassies were bombed in Africa but I don't remember exactly where. (S4)

The subject's retrospective verbalisation in (13) reveals that she processed the TU on the basis of her immediate contextual assumptions and it is impossible

to know whether she actually recognised the procedurally encoded information conveyed in (1a).

This occurrence provides us with interesting material concerning possible overlaps between procedurally and conceptually encoded information. The verbalisation in (13) reveals that S4's translation was carried out on the basis of her available contextual assumptions. In the RT framework, adjectives are, per se, conceptually encoded. However, the number agreement between noun and adjective in (1a) is procedurally encoded and it is important that this information be recognised for further inferential processing. The reference to bombings in (1a) is in itself an indicative of repetitive action and should suggest that the action of bombing took place in more that one instance, be it temporal or spatial. As a hypothetical example of the importance of the procedural encoding in the relation between U.S. embassy and bombings, one could envisage a verbalisation stating that "I knew that two embassies were bombed in Africa, but why is U.S. embassy here in the singular? They should have said embassies". Such a hypothetical verbalisation would show that without processing the procedurally encoded information in (1a), inferential processing would fall short of recovering all of the communicative cues conveyed by the sentence.

One may say that the inadequacies observed in the translations of (1a) in (2) to (5) are due to insufficient language proficiency in L2. This does not correspond, however, to the subjects' profiles. The corpus is obviously too small to allow for generalisations but the protocols may be used as indicators that the blending between procedurally and conceptually encoded information plays a fundamental role in the nature of human inferential processes in contexts of verbal communication, and equally so in contexts of translation.

With respect to our first hypothesis, we observe that, contrary to what we had expected, the recognition of the procedurally encoded information in (1a) did not occur as predicted. The process was hindered by the subjects' inability to retrieve the communicative cues conveyed in (1a) and to process the information procedurally and contextually encoded in the plural marking of the cluster under scrutiny. As a result, even if the fourth subject conveyed in (5) some of the assumptions of (1a), the subject's verbalisations show a low degree of interpretive resemblance between source and target texts.

Similarly to what occurred in (1a), the patterns of segmentation for the cluster "the lean, wolfish look of a revolutionary" were very similar among the subjects, with an average of 17':30" allotted to its processing. Here, however, pauses were much longer, there was the need to look the TU up in dictionaries and to search for complementary information from other external sources. This is what had been predicted in our second hypothesis, namely that the

Table 2. TU2: the lean, wolfish look of a revolutionary

Subject	Translog Elapsed Time Span	Retrospective TAPs – Extracts
S1	19':53"	I had some doubts with vocabulary [...] so I used a reconstruction using context
S2	20':21"	I used [...] large pauses for dictionary look-ups, for words like lean and wolfish. It didn't help me much [...]
S3	14':57"	I then opted for *não tão magro*, [...] a paraphrasing strategy. [...] I remembered what I had done for lean and wolfish. [...]
S4	14':52"	[...] Looking at the three pictures of bin Laden, I was helped a lot. As I am a medical doctor, bin Laden's transformation is evident to me.

subjects would draw extensively on their cognitive environments to process the conceptually encoded information in (1b) (see Table 2).

Transcripts (14) to (16) below clearly show that the TU was processed by means of contextual assumptions on the part of the subject. She started in (14) with a translation which neglected the conceptually encoded information conveyed by the two adjectives in (1b). Nearly five minutes later she processed the same TU again and after around seven minutes included *exótico* [exotic] as her interpretation of lean and wolfish.

(14)   [✱:05.36.00]Ele◆se◆tornou◆✱✱✱um◆líder◆revolucionário.◆(2c)

(15)   After [04.29.03]

◆[✍❀⊠⊠⊠⊠⊠⊠⊠→→→→→→→→→→→→→→→→◆✱✱mais◆
✱e✱✱✱⊠✱magro◆e◆mais◆e[✱:55.45]⊠⊠⊠⊠⊠⊠✱◆✱✱
mais◆[✱:01.34.82]encon✱⊠⊠⊠⊠⊠[✍]◆escondido◆nas◆
cavernas✱.✱✱[✍]⊠⊠⊠⊠⊠⊠⊠⊠A◆aparencia◆✱[✍]⊠ê
✱✱[✍]⊠⊠⊠⊠⊠⊠⊠⊠✱face✱✱[✍]◆[✱:02.40.84][✍]⊠⊠
⊠⊠⊠⊠⊠⊠⊠refugiado[✱:01.32.98][✍]◆exótico[✱:58.72][✍]
⊠⊠⊠⊠⊠⊠⊠⊠⊠o◆luxo✱[✍]◆✱✱✱✱✱[End] (S1)

(16)   I had some doubts with vocabulary for example, wolfish. I didn't find it in a dictionary, so I used a reconstruction using context. I had to make some choices when I decided to introduce exótico. (S1)

The subject mentions in (16) that she had doubts about vocabulary and made choices based on context. In fact, the conceptually encoded information was partially neglected and, as a result of that, a very weak interpretive resemblance between source and target text was achieved. Her comments were of a very

intuitive nature and are very much in line with the subjective remarks made by another subject in (12) and (13) with respect to the U.S. embassies in Africa.

A similar pattern emerges from transcripts (17) to (19). Like (14), (17) begins with a translation which does not take into consideration the conceptually encoded information conveyed by the two adjectives in (1b). Here, the TU was first processed on the basis of previously automatised information and translated rather intuitively on the sole basis of contextual assumptions on the part of the subject.

(17) ele◆ ✶ ✶ ✶tinha◆ ✶ ✶ ✶xxxxxxxxseu◆visual◆r⊠de◆revolucionário.◆(S2)

After six minutes, during which the subject had access to other reference materials, the subject went back to the TU. This time, there were several dictionary look-ups and relatively long pauses for reflective work. The process shows traces of recursiveness and the subject appears to work more reflectively on the translation task.

(18) After [06.39.41]
[⌃]grisalho⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ⊠ ✶ ✶ ✶ ✶ ✶ ✶ ✶[⌃]◆jovem⊠ ⊠
⊠ ⊠ ⊠ ⊠ ⊠[⌃]agressivo⊠ ⊠ ⊠ ⊠ ⊠ ✶ ⊠[✶:01.14.54][⌃]⌇
⌇[✶:01.20.95][⌃]Des✶gaste◆do◆terror[⌃]◆o◆⊗ ⊗O◆[✶:03.35.80]
[⌃]◆ ✶ ✶ ✶ ✶[⌃]á⊠[⌃]◆ ✶ ✶ ✶ ✶ ✶mais◆gorducho⊠ ✶ ✶ ✶[⌃]⊠
⊠ ⊠ ⊠ ⊠[⌃]⊠ ✶ ✶ ✶ ✶[⌃]vivendo◆⊠ ⊠ ⊠→→→→→→→⊠
ido⊠ ⊠ ⊠ ✶ ✶ ✶ ✶ ✶[⌃] ✶ ✶ ✶ ✶ ✶ ✶ ✶ ✶[⌃]à⊠ ✶ ✶ ✶ ✶ ✶ ✶ ✶ ✶
✶[⌃]Á⊠ ✶ ✶ ✶ ✶ ✶[⌃]⊠ ⊠ ⊠ ⊠ ⊠[✶:02.59.43][⌃][⌃]⊠ ⊠O⊠
⊠◆[⌃]◆cria◆⊗da◆na◆Arábia◆Saudita✶ ✶[⌃]quand⊠ ⊠ ⊠ ⊠
⊠ ⊠ ⊠ ⊠o✶ ✶ ✶ ✶ ✶ ✶ ✶ ✶[End] (S2)

(19) I consider my translation as a literal one for I've tried, and in fact I've done it, to adapt it sentence-by-sentence, or even word-by-word. I used pauses for reading, large pauses for dictionary look-ups, for words like lean and wolfish. It didn't help me much […] (S2)

As verbalised in (19) and similarly to what was observed in (16), the conceptually encoded information was partially neglected and a very weak interpretive resemblance between source and target text was achieved in (3).

Another similar pattern arises in transcripts (20) to (24). This time, however, the first rendering tries to incorporate at least part of the conceptually encoded information conveyed in (1b).

(20) [✶:55.61]ela◆ ⊗ ⊗e◆já◆tinha◆a◆aparência◆elegante[✶:57.57][⌃][⌃]
⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗sbelta[✶:01.21.47]◆e◆selvagem◆de◆uma◆ ⊗ ⊗◆
revolucionário.◆(S3)

(21)   After [04.42.00]

[✶:01.48.14]tinha◆feições◆mais◆[✶:58.73]⊠⊠⊠⊠⊠⊠⊠⊠⊠
⊠⊠⊠⊠uma◆aparência◆mais◆sadia✶✶✶,◆uma◆pl⊠alidez[✶:01.
52.76][⌂]apas⊠rentava◆estar◆mais◆fatigado⊠⊠⊠⊠⊠⊠⊠⊠
⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠resentava
◆sinais◆de◆fatiga[✶:01.12.74][⌂]estava◆mais◆gordo[⌂]✶✶✶não◆[
⌂]◆t~⊠ão◆magro◆como◆agro⊠⊠ora✶✶✶✶✶✶[⌂]✶◆(S3)

(22)   As I was using a monolingual English dictionary, I deduced by the
explanation given there for lean that in Portuguese this word would mean
esbelto, again by means the strategy of literal translation. And right after
typing *esbelto*, I stopped again to look up the word wolfish, which took me
again nearly 2 minutes, including the search and the revision. (S3)

The verbalisation in (22) above mentions deduction as part of the cognitive
processing of (4). However, one notices that this deductive process is, in fact,
supported by contextual assumptions on the part of the subject. As observed
in (23), there was no systematic linguistic or textual processing with a focus on
the conceptually encoded information.

(23)   For translating wolfish I had to use adaptation and naturalisation, since
the closest I could get to the idea of wolfish is wild. Therefore, I chose
selvagem. (S3)

However, the intuitive pattern is partially broken by the third subject in verbal-
isation (24) when she shows a recursive process which merges her translations
of "plumper, grayer and deathly pale" with what she had already translated be-
fore. This 'reflective' pattern, commonly observable among professional trans-
lators, is a rare example in our data.

(24)   Then I stopped again when I had to look up the word plumper in the
dictionary for. I figured out that it meant fatter, but not exactly fatter.
It was fatter in the sense of healthier. Then I started thinking of a way
of expressing the idea without mentioning the term *mais gordo*. I then
opted for *não tão magro*, which I considered to be a paraphrasing strategy.
I remembered what I had done for lean and wolfish. [...] (S3)

Finally, transcripts (25) to (28) complement the pattern observed throughout
in the data. In (25) the subject adds the noun *gosto* [taste] to her translation.
Since this is not conveyed in any sense by the source text, it is likely to assume
that there may have been a confusion between *gosto* [taste] and *rosto* [face] in
Portuguese, which, somehow, would account for the occurrence of *o gosto, a
face* ... [the taste, the face ...] in (5).

(25) [✶:01.12.23]adquiriu←←←←←←i⊠⇨✶•o•gosto•✶⊠,•←←⊠
⊠⊠⊠⊠⊠⊠a•✶✶✶⊠⊠o•gosto→•✶✶✶✶✶✶a•face•✶✶
✶✶✶←←←←←✶savage•→→→→•de•um•revolucionário←←←
←←←←←←←←←←←←←←←←←←←←←←←←⊠⊠⊠⊠⊠
⊠→→→→→→selvagem•⇨⊠⊠.•(S4)

After about six minutes, the subject went back to the previously translated passage and worked recursively on the TU.

(26) After [06.22.00]
[✶:01.10.82]↑→→→→→→→→→→→↑↑←←←←←←←←←←←
←←⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠⊠
⊠O•desgaste•⇨✶✶✶⊠⊠⊠⊠←←←←←←←←←←s←←←
←←←←←←s✶✶✶✶✶[᠌]⊠⊠⊠⊠⊠⊠⊠iado✶[᠌]⊠L
✶[᠌]⊠⊠⊠✶✶[᠌]⊠d[᠌]⊠⊠pelo✶✶✶✶✶✶✶✶✶→→→→
→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→
→→→→→→→→⊠E✶✶✶✶✶✶✶✶✶✶✶↓←←←←←←←←←
←←↓←←←←←←←←←←←←←←←←←←←←←←←←←←←
←⊠⊠⊠⊠⊠⊠alidez✶✶✶✶•(S4)

It is relevant to note the recursive movements observed in the transcripts above. They are corroborated by the retrospective protocol below.

(27) I didn't find this text difficult as it was presented to us and looking at the three pictures of bin Laden helped me a lot. As I am a medical doctor, bin Laden's transformation is evident to me. (S4)

(28) I had to use the dictionary to search for better terms for some words like acquired the lean, wolfish look and so on. I used literal translation many times, paraphrasing things like *adquiriu o gosto, a face selvagem, palidez mórbida* and so on. (S4)

Once again, although there are traces of processing the conceptually encoded information in (1b), verbalisations (27) and (28) show the same intuitive pattern observable throughout the data. The subject's claim that "As I am a medical doctor, bin Laden's transformation is evident to me" provides a striking evidence as to what extent contextual assumptions help and hinder the work of novice translators.

As far as our second hypothesis is concerned, we observe that the conceptually encoded information conveyed in (1b) was only partially recognised. In the RT framework, one could claim that the process was hindered by the subjects' inability to retrieve the communicative cues conveyed in (1b) and to process the subtleties of "the lean, wolfish look of a revolutionary". In fact, bin Laden's photographs used in the experiment only reveal signs of ageing and are

unable to justify the choices of *um revolucionário mais magro e mais exótico* [a thinner and more exotic revolutionary] by S1, *o visual magro e agressivo de um revolucionário* [the thin and aggressive appearance of a revolutionary] by S2, *a aparência esbelta e selvagem de um revolucionário* [the thin and wild appearance of a revolutionary] by S3, and o *gosto, a face selvagem de um revolucionário* [the taste, the wild face of a revolutionary] by S4. One could say that the use of the comparative form *mais magro* [thinner] by S1 and S2, and the translations of wolfish as *exótico* [exotic], *agressivo* [aggressive], and *selvagem* [wild] render the description of Osama bin Laden somewhat more belligerent than that conveyed by the source text. Even when the fourth subject conveyed in (27) some of her assumptions about bin Laden's medical condition and used her medical authority to state that "as I'm a medical doctor, bin Laden's transformation is evident to me", she was making use of her cognitive environment to process as contextual assumptions the communicative cues present in (1b). The verbalisations also indicate that the impact of the events after the September 11 incident led the subjects to draw heavily on their contextual assumptions and neglect more explicit forms of linguistic encoding. With this respect, one could say that the four translations in (1b) show in contrast to those rendered in (1a) a relatively stronger interpretive resemblance between source and target texts.

A common pattern seems to emerge from our analysis of transcripts (14) to (28). The thoughts verbalised with respect to (1b) reveal a great deal of intersubjective convergence among the four subjects. There was always a first phase of more automatised processing (see Königs 1987, 1990 and Alves 1995 for a distinction between two modes of processing in translation, i.e. automatised and reflective modes of performance), as observed in (14), (17) (20), and (25). These were followed, at an average of five minutes later, by observable improvements on the target texts, almost always accompanied by comments which highlight the role played by their cognitive environments in the unfolding of their inferential processing.

The same recurrent pattern was observed throughout the translation task among the four subjects. Apparently, all of them had plenty of time to perform the task and did not report time pressure or cognitive overload. It appears that as time goes by the subjects' processes are prone to change into a more 'reflective' or 'analytical' mode of translation (see Gutt 2000b: 169). Their cognitive profiles also seem to be very much in line with considerations made by Alves, Magalhães & Pagano (2001) with respect to the cognitive profiles of novice translators.

Based on the considerations raised above, we intend to carry out an experimental research among three groups of subjects, each one of them with a

different level of translation competence (Gonçalves, 2003), and cross-analyse data from EFL students, professional, and novice translators. From these different profiles of translators' performance patterns, we aim at obtaining a considerable amount of reliable data to be analysed under the theoretical framework we are dealing with in this research and, thus, investigate further the role of inferential processes in translation.

Conclusion

We hope to have shown that by means of an empirically oriented research with TAPs and *Translog* protocols it is possible to map the recursive movements of translators and to identify parameters of relevance in their problem solving and decision making processes. We also hope to have shown that, through a relevance-theoretic perspective, the recursiveness and plasticity of translation processes and the role played by intersubjectivity in their unfolding may become amenable to scientific investigation. By bringing the triangulation of retrospective TAPs and *Translog* protocols into our experimental design, we believe to have contributed to an improvement in the methodology of process oriented research and thrown more light onto the discussions about the inter-relations between cognitive and inferential processes within translation contexts. (Alves, Gonçalves & Rothe-Neves 2001).

For now, we would like to emphasise the inter-relation between contextual assumptions and decision making in culturally marked contexts. We also hope to have provided evidence for the role of contextual assumptions in handling procedurally and conceptually encoded information, and shown that a relevance-theoretic view of translation processes may be able to account for how implicatures and explicatures are expressed in different cognitive environments and, therefore, in different target texts. Finally, we hope to have shown that inadequacies in translation are not necessarily the result of wrong encoding; they may arise mostly as a result of weak contextual effects. Thus, it becomes difficult to arrive at any instance of interpretive resemblance, if procedurally and conceptually encoded information are not handled adequately by translators.

Returning to Gutt (2000b: 169), we may say that there was a great deal of intuitive work among our four subjects, mostly when they had to deal with contextual information which was not yet consolidated in their cognitive environments, i.e., information available in rather 'artificial' contexts. The case of Osama bin Laden was most instrumental for it allowed subjects to deal with

information widely available in the international media at the time of writing, and yet extremely controversial in its subjective level. It would certainly be interesting to investigate how professional translators would deal with the same situation. Would they perhaps work more 'reflectively' or more 'analytically' as Gutt suggests? It is certainly worth investigating how this process occurs among groups of professional vs. novice translators and observing if there are significant changes as training progresses. This will be the object of another study to be conducted on a much larger scale.

Notes

1. For comments on the different modalities of TAPs, see Hansen 1999. For more specific questions related to TAPs and cognitive overload, see Jakobsen, this volume.

2. The four subjects will be identified as S1, S2, S3, and S4. Their identification will appear between brackets after the transcripts of retrospective verbalizations and Translog protocols.

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Controlling the process

Theoretical and methodological reflections on research into translation processes

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One of the dilemmas in empirical translation studies, when investigating translation processes and products, is caused by the fact that we would like to divide them into many different phenomena and investigate these separately under controlled experimental conditions, avoiding disturbing variables. In reality, however, processes and products cannot be divided clearly into small, discrete parts. They comprise a complex network of factors, such as assumptions, decisions, feelings, thoughts, impressions and doubts. These in turn are influenced by several conditions, like the individual background of the translator, who is the subject of the experiment, the actual situation and conditions of the experiment, and the observer, who interprets the actions during the process and the results. In this article I argue that phenomenology, an approach derived from human experimental psychology, has dealt with this dilemma and provides useful methods and ideas for improving the field, such as the idea of aiming at increasing clarification via triangulation and the precise description of data from different sources.

Introduction: *TRAP*-project

My research project is a part of the *TRAP*-project (*TRAP* = "Translation process"), an empirical research programme that was started at the Faculty of Modern Languages at the Copenhagen Business School (CBS) in 1996. Researchers from three different departments – English, Spanish and German – worked together on a project in Translation Studies called "The translation process: from source text to target text". The project is described in Hansen et al. (1998a, 1999). The parts of the translation process which I have decided to focus on are the evaluation phases and, especially, the interaction between

the translators' skills, knowledge and competences and their ability to keep processes and products under control (Hansen 1997:207).

In his books and articles, the Hungarian-American psychologist Mihaly Csikszentmihalyi describes what he calls a "flow experience". It comprises all the enjoyable experiences a person can have during a successful activity: a feeling of great activity, total absorption, awareness and psychic energy. In this connection Csikszentmihalyi (1996:116) says that creative individuals and experts possess the ability to give feedback to themselves. They have a clear goal and are in control of their actions. They feel and know at once if they have done something really well, or not so well.

It is this feeling of satisfaction or displeasure that I have tried to capture in my research in translation processes. In addition, I have observed my subjects' individual behaviour, habits and strategies during the process (Hansen 1997, 1999a, 2002a).

A short definition of *translation* and *translation process*

Translation for the *TRAP group* means "real life translations" of complete authentic texts that have a social, communicative function in a defined communication situation. This involves a commissioner, user-oriented texts and a target text receiver (Hansen 1995:25). In short, our translations are pragmatic translations of what Weinrich (1976:16) has called "texts in a situation".

The *translation process* is defined as everything that happens from the moment the translator starts working on the source text until he finishes the target text. It is all encompassing, from every pencil movement and keystroke, to dictionary use, the use of the internet and the entire thought process that is involved in solving a problem or making a correction – in short everything a translator must do to transform the source text to the target text.

Controlling the process

The title of this article, "Controlling the process", can be understood in a variety of ways, for example:

1. Translators controlling their translation processes – "controlling" in the sense of translation monitoring and the control of translation quality.

2. Teachers/researchers controlling translators' translation processes – "controlling" in the sense of investigating translation processes for example by using different types of introspection.

3. Researchers controlling the research process when investigating translators' control of their translation processes. This kind of "meta-control" involves a great complex of epistemological and methodological reflections. Some of them will be described in this article.

As research in translation processes shows, all three kinds of "controlling the process" are difficult and sometimes problematic.

Process research started with Krings (1986), Gerloff (1987) and House (1988). Other scholars like Tirkkonen-Condit (1990), Jääskeläinen/Tirkkonen-Condit (1991), Lörscher (1991), Kiraly (1995), Kussmaul (1998) and Jääskeläinen (1999) produced important results. The dominant research method was the use of think-aloud-protocols (TAPs).

The possibility of combining introspective methods, TAPs and retrospection, with a computer program like *Translog* (developed by Jakobsen 1998, 1999a, 1999b and this volume), has changed and improved the study of translation processes. The computer software provides us with *quantitative,* more *objective data* about processes, allowing us with its "view function" to see all movements, corrections or changes as well as the position and length of all phases and pauses during the process on a log file. It is also a tool that enables us to design new experiments, involving for example various aspects of "time", such as different kinds of time pressure. With its "replay function", which shows the whole writing process dynamically on the screen, *Translog* makes it possible to use the method of "recognition", a frequently employed method in psychology.

Translators controlling their translation processes

Translators' ability to control their processes and their ability to change them depend not only on the translation task but, to a large extent, also on their skills, knowledge and translational competence. Experiments with *Translog* and retrospection gave indications, that translators sometimes translate "automatically"; they feel a kind of "flow" and become aware of a poor translation at once, enabling them to find better solutions without great effort. At other times they have to spend a lot of time thinking about a possible solution for a translation problem (reception or production problem). They consult refer-

ence books and other sources, and attempt to take into consideration all aspects of the commission, the communicative situation, the TT-receiver's presuppositions, coherence, grammar, style etc. before they decide whether their initial solution is adequate.

Sometimes translators just seem to feel or know when things are right or wrong and are able to control their processes nearly automatically. On other occasions they encounter a lot of problems, making control a conscious act during the translation process.

Translators do not normally think much about their translation processes and can therefore not tell us much about them. Kiraly (1995:41) states that "translation processing is probably a mix of conscious and subconscious processes – a mix that may change as translators proceed through their training and become more professional." Kiraly (1995:94) says that many processes are uncontrolled processes and that "only indicators of relatively controlled processes are likely to appear in TAP-data; relatively uncontrolled processes will continue to escape this kind of inspection." His main interest is the pedagogical application of his research to processes and his assumption is that in order to teach translation properly, it is necessary to understand both the uncontrolled and the controlled processes and the interaction between them.

Translators evaluating their translation product or parts of the product

Some translators read parts of the translated text during the process and most translators read and revise the whole target text after having finished writing (Hansen 2002b:48ff.). A condition for being able to evaluate translation elements or the whole translation product is that the translator has developed a sense of correctness. The translator must have some idea of the ideal product and be able to compare this idea with his or her actual product. Until recently, translation teachers hoped to promote this through discussions of translation products. Textual analysis of source texts and the study of parallel texts are used as means to internalise models. Extensive reading in both languages can have a similar effect.

Control implies some idea of a goal and how to achieve it. In connection with his flow chart depicting mental processes in translation (Hönig & Kussmaul 1998:175), Hönig mentions the importance of the translator having an idea of what the target text will look like (*Erwartungsstrukturen in bezug auf den prospektiven Zieltext*). Translation monitoring may take place automatically and this is fine until a disturbing element appears. Depending on their

skills and competence, translators realise that there is a problem and try to make changes, thereby adapting their product to their notion of the ideal product. Especially in LSP-translation, translators need a great deal of practice and knowledge in special fields to be able to imagine the "ideal" product and, thus, to be able to evaluate their own translation.

Controlling translators' translation processes

In my investigation of translators' control of their processes, I concentrated on an analysis of their monitoring skills i.e. their ability to spot and solve translation problems, and their ability to evaluate their tentative translation elements and their target texts. In addition, an attempt was made to analyse the degree of self-awareness with regard to their actions and habits during the process of translating.

Short description of the project design: the subjects were 47 postgraduate students from the CBS – in fact, all the students who took my translation courses in 1997/1998, and 6 postgraduate students from the Fachbereich Angewandte Sprach- und Kulturwissenschaft der Johannes-Gutenberg-Universität Mainz (FASK) in Germany (Hansen/Hönig 2000). The experiments proceeded as follows:

– They filled in questionnaires about their individual background, including educational background, development and use of their languages, reading habits, age, etc.

– After some tests of their writing speed, they were allowed to read the source text quickly. Then, in the first translation, the text was translated passage by passage under individual time pressure. For the individual time pressure, the first passage appeared immediately on the screen, and the next passages appeared after an individually predefined period of time and then disappeared again when the next passage popped up on the screen. "Individual time pressure" means that each of the subjects had a period of time at their disposal that was adapted to their individual writing and translating speed (for the texts and the time pressure see also Hansen/Hönig 2000 and Hansen 2002a). They had enough time to translate spontaneously but not enough time to change anything in this first version.

– I combined this first translation with a second translation of the same text, without time pressure (translating into the foreign language) or two parts

of a text with an overlapping passage (translating into the mother tongue). This followed immediately after the translation with time pressure. For the translation without time pressure, the subjects not only saw the source text on the screen, they were also given a paper version of the original text. For the second translation they had as much time at their disposal as they wished and had access to all the reference works they asked for.

– After translating, the subjects were given the chance to look at a hard copy of their translation without time pressure in order to correct their product. (This was only possible in the experiments at the CBS.)

– I mentioned earlier that *Translog* has a "replay function", where the whole writing process is shown dynamically on the screen. For my study, I combined this replay function with retrospection. For the retrospection with replay, the translation without time pressure was shown, and my subjects were asked to describe what went through their minds during the process and what kind of reference works they had used.

– During the experiment, when the subjects revised their hard copy, I recorded changes between the first and the second translation and marked both problematic and perfectly translated passages. In an interview after the retrospection with replay, I asked them for further clarification of their problems and gave them feedback.

Short description of the analysis of the results: The translation with time pressure gave indications about how the subjects translate automatically and spontaneously in a stressful situation, while the translation without time pressure gave indications about their competence under what they consider to be normal translation conditions. This showed how they proceeded from their first draft, the problems they encountered and the strategies, or lack thereof, that they used to solve these problems. It also demonstrated how they rejected many good solutions from their first translation in the second translation.

The target texts, log files and transcriptions of the recorded comments from the retrospection were analysed anonymously. In my analysis, I studied the subjects' ability to control their processes and products at several checkpoints, which had been established prior to the experiment:

– At first, I recorded all the changes between the two target texts. These changes were my first point of control or *checkpoint* 1.

– I mentioned that *Translog's* "view function" makes it possible to see all movements, corrections and changes as well as all phases and pauses during the process via a log file. My next point of control was the study of the writing phase of the process of the translation without time pressure.

On the log files, I registered all improvements and discounted all new errors that had an influence on the quality of the translation product. The study of movements, corrections and changes during the writing phase of the translation process constituted *checkpoint* 2.

– Many corrections and changes are undertaken in the revision phase. Therefore the study of the revision phase of the process via the log file was my *checkpoint* 3.

– A study of the corrections the subjects made on their hard copy constituted *checkpoint* 4.

– As mentioned earlier, retrospection with *Translog's* replay function gives the possibility of recognition. With the replay function the observer can direct the attention of the subjects to their experience. In my experiments, the replay on the screen kept the subjects concentrated on the task of recounting what had gone through their minds. Notably the pauses made them remember their problems (see Hansen 1999a: 45). I registered these thought processes – which problems they mentioned and which ones they ignored, whether they had been able to solve them or not, and if they were aware of errors or overlooked them. This study of their ability to comment on the process and to improve weak passages was my *checkpoint* 5.

Researchers controlling the research process

One of the problems in experimental translation research is that it is difficult to isolate variables and to eliminate disturbing individual features. My assumption from translation teaching was that there must be great individual differences between translation processes and the ability to keep the process and product under control. I hoped to be able to establish individual and general competence patterns (Hansen 1997: 209). For this reason, both in my experiments and when analysing the results, I tried *not* to eliminate individual features, but to take as much information as possible about the translators' individual conditions and backgrounds into account. The dominant impression from studying the log files and retrospection of more than two hundred translation processes confirmed my assumption. Although there are many similarities – the individual processes are quite different. These differences may be due to a plethora of factors, such as the translators' personal histories and individual backgrounds, their different temperaments, interests, their attention, knowledge, degree of self-confidence, competence in L 1 and L 2 and their strategies, or lack thereof. Sometimes physical conditions also play an impor-

tant part. Approximately one in three of my subjects displayed special habits which had an impact on their ability to control their processes and products.

Investigating mental processes

The consequences of looking at individual translation processes together with the translation products, instead of looking at the products alone, are immense. This gave rise to many new problems – covering the huge complex of episte-mological and methodological problems that psychology has battled with for centuries. It is impossible to avoid taking a stand on these problems which have an influence on every decision: the research design, the choice of subjects, the instructions, the analysis of data and the description of the results.

For this type of study, a useful theoretical and methodological framework turned out to be *phenomenology*, a method of experimental psychology. One of the concerns of phenomenological psychology is the analysis of all aspects of subjective experience. Phenomenological studies focus on qualitative data from the first-person perspective, i.e. what we know as introspection, the subjects' verbal accounts of their thoughts and experiences. This data is combined with data from the third-person perspective, which is the observer's perspective.

The phenomenological approach has some weaknesses, especially the fact, that the methods cannot live up to the requirements of natural sciences that demand accurate, objective, quantifiable, replicable and verifiable findings. As each of the observations with introspection is unique and totally dependent on the subject's/experiencer's individual private experience, replicability is virtually impossible. Different experiencers cannot have identical experiences. The same experiencers cannot have totally identical experiences at different times. So introspection and the first-person perspective were, and are, often considered to be unreliable, and qualitative methods are sometimes regarded as unscientific or as "pseudo science" (Morgan 1998). Phenomenological studies of consciousness in present-day research discuss these epistemological problems. Pickering, for example, states:

> However, science strives to give us as complete an account of the world as possible, without mysterious gaps. Hence if consciousness is to be investigated scientifically, it needs to be considered in *all* its aspects. The first person perspective needs to be included in psychology despite the misgivings of those for whom empiricism and objectivity are the essence of scientific practice.... First-person methods enrich research because they provide data that cannot be got in any other way.   Pickering (2000: 279f.)

Phenomenology demands pluralism, including for example a combination of qualitative and quantitative data, subjective and objective aspects, and in addition also individual, social and cultural conditions (Pickering 2000: 280). The different approaches using phenomenology deal with the same problems and ask the same questions: how can the findings from first-person methods be translated into a systematic intersubjective science? There are problems with the effects of the observer on the experiment and on the experiencer. There is the great problem of creating some kind of general understanding that goes beyond private experience. The crucial question is as Velmans (2000: 337) expresses it: "how can one obtain public, objective knowledge about private, subjective experiences?"

Intersubjectivity

It is an advantage to be able to *triangulate* qualitative first person and third person investigation with methods and technical devices that give quantitative results (Pickering 2000: 290). But there will always remain "observer effects" – especially where we deal with an observer of a human experiencer expressing his or her experiences and thoughts. In this situation both are observers and their experiences are seen from their individual or private perspective, which is subjective. In early phenomenology, a solution or compromise was found in the notion that shared similar experiences can lead to *intersubjective identification*, i.e. observers can aim at *more and more precise description* and through negotiation reach an agreement about privately observed phenomena (Tranekjær Rasmussen 1967: 23). The observer effects can be isolated in the "no", i.e. in those cases where observers or the observer and the observed do not agree with each other. In such instances they have to negotiate and clarify what the other party or the subject/experiencer really meant. The shared perspective that can be reached by negotiation is sometimes called "the second-person perspective". It presupposes not merely shared experiences but as Velmans (2000: 343) describes it "one also needs a shared language, shared cognitive structures, a shared world-view or scientific paradigm, shared training and expertise and so on."

Communication

Communication has always been an important aspect of the phenomenological approach. Communication between researchers and experiencers depends on

encoding and decoding, i.e. it depends on the experiencers' ability to express themselves and the researchers' ability to interpret what they have heard. A methodological problem is how first-person experiences can or should be described by the experiencer and whether an experiencer can identify a problem if he or she does not know the concepts and words to identify or describe it. This is the classic philosophical and psychological problem of "the power of language over thought" that concerned people like Luther, Goethe, Sapir/Whorf, Vygotsky and many others. Wundt (1874/1888), the founder of experimental phenomenology, was already aware of this problem. He trained his subjects to report their own sensory experience as consistently and precisely as possible. Lewin (1922: 195) says that it is the task of the experimenter to teach the subjects to give reliable reports of their experiences (*Erziehung der Vp. zur richtigen Selbstbeobachtung*). This is one of the reasons why "classical introspection", as it is called (Jääskeläinen 1999: 64), is sometimes rejected by scholars of today. Their argument is that teaching the subjects "how to report" destroys the data because this implies that the subjects have already been told "what to experience and what to say". Nevertheless, Wundt's idea of giving subjects a language with which to express their thoughts seems quite progressive. Well-known examples from the world of individual perception of how important it is to teach specialists to express their experiences can be found in the fields of wine or coffee tasting, as described by Broadbent (1975), or in the field of perfume testing. The tasters and testers are taught the vocabulary of tastes or smells before they are able to describe their experiences.

In all kinds of research with introspection or retrospection, we have to ask ourselves: What kind of information do we get from our subjects/experiencers? Most likely, we only hear about phenomena that they at some point in their lives have learnt to talk about. But what about other phenomena? Are they not aware of those? Perhaps they are simply unable to express their thoughts explicitly. During the retrospection with replay in my experiments, I observed that some of my subjects had held long pauses and made many movements that obviously showed that they had tried to solve a problem. In retrospection, however, they only produced vague comments like "I feel ..." or "this sounds ..." or they just remained quiet. Like most other researchers in this field, I had followed Krings (1986) and Ericsson and Simon (1993) and asked my subjects to describe "what was going through their minds". I could see that there was a lot "going through their minds", but they were not able to find the words to express it.

Perhaps a person does not need terms like "metaphor", "prolepsis" or "nominalization" to be able to translate but the translator must be aware of

the existence of such phenomena – otherwise he or she cannot detect them and talk about them. Moreover, one normally learns the terminology at the same time as learning about the phenomenon.

The fact that experiencers have learnt terms with which to express their thoughts does not automatically imply that they also have been told *what to say* during the experiments. Over many years, I have observed that it is much easier for our students to comment on and revise translations into a foreign language than translations into their mother tongue, and they prefer doing so. The reason might be that they have learnt the foreign language consciously, and have acquired the terminology to describe potential problems. I assume that the same observations, namely that we obtain more information about translation processes into a foreign language than into the mother tongue, can be made in our research with TAPs or retrospection with replay.

Sources of information about processes and products

In my research, I combined relevant quantitative and qualitative data in different ways and tried to analyse them in relation to each other. "Relevant" means that they provide the possibility of creating new knowledge. In the following section, I will try to characterize the data I could obtain from my experiments in relation to the phenomenological approach.

Evaluation of the translation product

An important, if not the most important, source of data in this kind of research is the evaluation of the target texts. Processes are not very interesting if they cannot be seen in connection with any kind of result, the translation product (Hansen 1999a: 51ff.). Evaluation data are qualitative third-person data, which are elicited through the evaluation of the final translation product. But also corrections, changes and new errors during the process, for example after pauses, have to be evaluated. Though it would appear that quality assessment is very subjective, evaluators can use a procedure of describing their evaluation criteria precisely and of negotiating and compromise when a dispute arises. However, as Gile (1999: 56) points out, it is important to be aware of the extent of intra-group variability. It may not be substantial. There may be observer effects, but as before, it is possible to reach a kind of intersubjectivity. As to the evaluation of errors, the phenomenological method of accurate description and clarification becomes important, because then every reader of the results of

a study can make a decision as to whether he would agree with the evaluation criteria or not.

Log files

As mentioned above, with *Translog* the researcher has the possibility to observe the writing process on a log file, which provides quantitative data about all movements and which shows all phases and pauses. Logfile data are objective third-person observations, but the evaluation of the results of the movements after the pauses are not. For this reason, it is necessary to interpret and discuss them. Although the software gives an exact and objective account of phases (preparation phase, writing phase and revision phase) and pauses (position, number and length of pauses) during the process, the researcher and the subject do not really know what happened during these phases and pauses. In some of my experiments, the subjects' annotations on the paper version of the source text showed a part of their actions during the preparation phase, and their comments during the replay showed what they believed to have thought and done during the phases and pauses (Hansen 1999a, 2002a: 18). Often the movements directly following the pauses, which can be seen on the log file, gave an indication as to what had happened during the pauses. However, it is always necessary for the observer to evaluate and interpret the movement after the pauses, a process where interpretation is subjective. If it is discussed with other evaluators, the process can become intersubjective. Seen together, the two kinds of third-person observations – the evaluation data and the data from the movements on the log file – can be considered to be very reliable, because data from the product have to match data from the process. Many of the movements made during the processes and at least the last movements are reflected in the final product.

To get more precise results, i.e. to get closer to the causal relationship between what happened during the translation process in relation to the final translation product and the quality of it, I used the combination of observations from the log files and observations from the retrospection with replay (Hansen 2002a, 2002b).

Third-person observation of the first-person intro/retrospection

During the replay, the subject recognises the thoughts and problems he or she experienced during the process and the researcher is provided with this information, especially during the pauses. Sometimes the subjects try to explain

their solutions and sometimes they explain what they "normally" do (see also Hansen 1999a: 45ff.). Information from retrospection is private and subjective – but to some degree it can be controlled. The researcher does not only see all the movements in the process together with the experiencer, but also has access to a great deal of data from the process (log file) and from the product. These all have to fit in with the comments during the retrospection with replay. Thus the phases and pauses, the replay and the comments, as well as the movements directly after the pauses, all supplement each other. Seen as a whole, they give a very clear picture of what happened during the process.

Further explanation for clarification

All this information and data may not be sufficient. There are situations where it is necessary for the observer to ask for further explanation. In such cases, the combination of all the methods, is a great advantage. During retrospection, where the first-person observer (experiencer) and the third-person observer (researcher) look at the replay of the same process on the screen and see the same pauses, movements and decisions, it is easy to identify a problem and to go back to it and work on further clarification during the following interview.

Questions after the experiment/questionnaires

Sometimes all the data from the log files of the process, combined with the results of the product evaluation, the comments from the retrospection and further explanations are still not enough to interpret and clarify all observations during individual processes. It may even be necessary to ask the subject for further clarification *after* the experiment. The questionnaires about the individual background of the subjects can also provide a source of useful information.

Some examples

At every of my checkpoints (p. 30/31), data from different sources were combined – sometimes only data from two sources and sometimes data from them all. The following three examples from my experiments show how they can complement each other. Sometimes quantitative data are explained by qualitative data and sometimes data obtained from different sources mutually support each other. However, in this context, I cannot give a description of the

relation between all the relevant data or the whole investigation of the ability to control processes and products of the subjects mentioned.

The examples show combinations of qualitative and quantitative data in relation to one aspect of my experiments – the use of reference works. During the stage that I describe as checkpoint 2, I can register the translators' search for information during the translation process and their decision of what can be used. On the log files, one of the indices of search for information, for example the use of reference works, is the presence of longer internal pauses of 30 seconds and more, and the movements in the process immediately after these pauses.

Log files from the experiments

I looked at three *log files* from three different translations without time pressure, i.e. where the translators had had as much time at their disposal as they wished. They show that all three translators exhibit many long *internal pauses*. One of the log files (*A*) has been taken from the experiments at the FASK in Germersheim – a translation from English into the mother tongue German. The other two, *B* and *C,* are from the experiments at the CBS: *B* is from a translation from German into Danish, and *C* is from a translation from Danish into German.

The long pauses in the log file are quantitative data, and need not be discussed. What should be discussed is what the translators did during these long pauses. As stated earlier, this cannot be seen from the log files.

Their products from both translations, with and without time pressure, received the following assessments from two evaluators (Hansen 2002b: 35):

With time pressure	*Without time pressure*
A not acceptable	not acceptable
B good	good
C not acceptable	good

What is the connection between the long internal pauses (log file) and this result (evaluation)? Without further data from third-person observations of the process (log file and/or replay) and/or first-person data from the retrospection with replay or from further explanations, *it is impossible to answer this question*.

Regarding subject *A*: When Dr. Hönig and I conducted the experiments at the FASK, we observed that the German subjects hardly ever used dictionaries (Hansen/Hönig 2000: 336). *A* used the dictionary only three times. During the long retrospection with replay, she didn't say much. The movements on the log

file after the pauses did not explain what happened. At last we had to ask her for an explanation of what went on during all those pauses. She said:

> *Ich habe ziemlich lange überlegt. Das Problem ist (beim Wörterbuchgebrauch), man haftet zu sehr an den Wörtern und es bringt nichts. Es bringt wirklich nichts. Es wird nicht besser dadurch.*
> [I thought about things for quite a long time. The problem is that (when you use a dictionary) you stick too much to the words and it doesn't help. It really doesn't help. It doesn't make it better.]

This explanation shows that *A* used nearly all her long pauses to think.

Translator *B* explained during the retrospection, that she had consulted a dictionary 19 times (the average for all 47 subjects was 8). From the log file, I could see that she had found 13 successful solutions after the pauses in which she had looked up words. She said that she consulted the dictionary mostly to get ideas, but 5 times she stated that she looked something up just to be sure. In the translation with time pressure she had shown that she was a good translator under all conditions, with or without dictionaries.

Translator *C* was highly unusual. She said in the retrospection that she looked up everything: "If you haven't any idea of what things are called, you only have the Danish-German dictionary." She did not use remarkably more time than the other subjects, although she says that she consulted one or more dictionaries on 37 occasions (the average was 11 times). Her product and the words and idioms she used immediately after the internal pauses (seen in the log file) showed that 29 of these 37 consultations were successful, on 5 occasions she made an incorrect choice and 3 times she could not find anything of use.

In the case of *C*, the data from the log file, the product evaluation, and her comments and explanations during the retrospection and interview were insufficient. They could not explain the reasons for her exaggerated use of dictionaries. Consequently it was necessary to ask further questions after the experiment. It turned out that she had had an English teacher who had systematically trained his pupils to use dictionaries. He had given them texts as cloze tests, where there were gaps, which had to be filled in. She told me that since that time she had looked everything up and double-checked, both in bilingual and monolingual dictionaries. She had done this for about 15 years, and throughout her studies at the CBS, without anyone ever noticing it.

The quantitative data from the log files showed that translators *A*, *B* and *C* all used many long internal pauses. During the retrospection, *A* appeared to be helpless. She could not identify her problems, could not talk about them

and/or did not have any method or strategy to solve them. She was unable to find any help in dictionaries. *B* had only one problem. She didn't take risks. She was quite aware of her own process, and the experiment convinced her that she was able to translate well without so many dictionary consultations. My conclusion about *C* was that her translation competence depended almost entirely on a very special kind of competence, i.e. an extremely well developed competence in dictionary use. She had not been aware of this. It would appear that she needs translation training without dictionaries. Otherwise her life as a professional translator will not be easy because it will cost her too much effort to solve translation tasks.

In all three cases, the combination of quantitative and qualitative data from different sources (pauses (log files), product (evaluation), retrospection, interview and questions afterwards) allowed both the subject and me to move from subjective to intersubjective identification and, thus, closer to a clarification of what happened during the processes and the relation between the processes and the products.

Conclusion

My area of interest was "Controlling the Process", and especially the research process. I found that phenomenological methods of observation with their holistic and pluralistic approach, together with triangulation of qualitative and quantitative results are very useful. Through increasingly accurate description and negotiation of observations from different sources of data, we can get closer, perhaps not to an "objective" result, but to shared replicable experiences and results.

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Building a translation competence model

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This chapter presents the translation competence model that is being worked on by the PACTE group and that is the basis for designing the hypotheses of an empirical-experimental study of translation competence. This research is the first stage in a larger project to investigate the process of translation competence acquisition. The first part of the chapter describes our theoretical framework and the first models that we designed in 1998. This is followed by a brief presentation of the design of the research project. The last part of the chapter deals with the modification we have introduced in our 1998 translation competence model as a result of the first exploratory studies.

Introduction

The PACTE research group (Process in the Acquisition of Translation Competence and Evaluation) was formed in October 1997 to investigate the Acquisition of Translation Competence in written translation into and out of the foreign language (inverse and direct translation). All the founding members of the group are translators and translation teachers who train professional translators in the Facultat de Traducció i d'Interpretació of the Universitat Autònoma de Barcelona. Our language combinations include English, French and German ↔ Spanish and Catalan. We cover both direct and inverse translation directions. This means that we all have different theoretical and methodological backgrounds, but for a long time we had all felt the need for more information about how trainee translators learn to translate in order to create better teaching programmes, improve evaluation methods and unify pedagogical criteria. Therefore, in 1997, we decided to form a research group. Our first objective was to unify criteria, so our first task was to build a model of the characteristics

that define the professional translator (translation competence) and a model of how translation competence is acquired (translation competence acquisition) that could be validated empirically. We also had to decide on an appropriate research design.

We started from the concept of translation as a communicative activity directed towards achieving aims[1] that involves taking decisions and solving problems,[2] and requires expert knowledge, like any other activity with these characteristics. In Translation Studies, this expert knowledge is called Translation Competence. Consequently, the first stage in our research project is an empirical study of how written translation competence functions, as there is no generally accepted translation competence model that has been validated empirically.

In our research, translation competence is being studied from two complementary points of view: (1) the translation process, through the collection and analysis of data obtained from experimental studies of the mental processes used to translate, and the competencies and abilities required; (2) the translation product, through the collection and analysis of data obtained from an electronic corpus consisting of the texts translated by the subjects participating in the experiment. Different instruments and different types of data-collecting methods are being used, both qualitative and quantitative methods, so that the data can be collated and triangulated.

There are two main stages in our research project: (Stage 1) an empirical study of translation competence; (Stage 2) an empirical study of translation competence acquisition.

This chapter centres on the translation competence model on which our research is based.

Theoretical framework and models

In 1998, PACTE developed a first version of a holistic model for Translation Competence and a dynamic model for the Acquisition of Translation Competence (PACTE 1998, 2000, 2001; Hurtado Albir 1999, 2001: 375–408). Our theoretical and working hypotheses are based on these models.

Theoretical framework

These models were constructed taking into account: (1) existing work in other disciplines that have defined notions related to translation competence acquisi-

tion; (2) models proposed to define translation competence and the translation competence acquisition; (3) empirical research on written translation.

1. Research into notions, such as "competence", "expert knowledge" and "learning processes" in other disciplines (e.g. pedagogy, psychology and language teaching).

Given that we consider translation to be an act of communication, we have drawn on studies of communicative competence.[3] These studies stress the difference between competence (defined as a system of underlying knowledge and abilities) and the activation of this competence under certain psychological and contextual conditions. Furthermore, these studies consider that this competence is made up of a set of inter-related sub-competencies, amongst which are those needed to language use. Fundamental importance is given to the strategic component to plan, repair, evaluate and carry out the process. Some authors (e.g. Bachman 1990) also include psycho-physiological mechanisms, that is the psychological and neurological processes implied in the real use of language.

However, translation competence, that is the professional translator's competence, differs from communicative competence in that it is expert knowledge. The characteristics of expert knowledge and its acquisition have been studied in psychology, cognitive psychology, pedagogy, etc.[4] Expert knowledge is defined as being categorical or abstract and having a wide knowledge base; it is conscious and can be made explicit; it is organised in complex structures and can be applied to problem solving.

An essential element in understanding how expert knowledge works and is acquired, is the distinction between declarative and procedural (or operative) knowledge made by Anderson (1983).[5] On the one hand, declarative knowledge consists of *knowing what*: it is easily verbalised; it is acquired by being exposed to information and its use is normally controlled (e.g., knowing the addresses of web pages that are useful for translator documentation). On the other hand, procedural knowledge consists of *knowing how*: it is difficult to verbalise; it is acquired through practice and its use is mainly automatic (e.g., knowing how to use a web page to guarantee a translation's precision and economy). The procedures with which this knowledge is acquired or built (strategies and techniques) are very important.

The acquisition of expert knowledge passes through different stages. Beginning with the initial stage (novice knowledge), the knowledge gradually becomes more automatic until the final stage (expert knowledge) is reached. This acquisition can be natural or guided, through teaching, but in both cases there is a learning process. Studies of learning processes stress that the acquisition of

any knowledge is a dynamic process, cyclical rather than lineal in nature. The process includes successive stages of restructuring knowledge in which learning strategies play an essential role (i.e., the operations used by the learner to obtain, store, recover and use information).

2. Models used to define "translation competence" and the "acquisition of translation competence".

Unlike other disciplines in which numerous studies have been carried out to determine what constitutes expert knowledge in the field and how this knowledge is acquired, no generally accepted model of what constitutes translation competence or the acquisition of translation competence exists in the field of Translation Studies. Some proposals have been made with respect to translation competence in written translation.[6] Most, however, are limited in scope as they deal only with specific aspects of translation competence. All the proposals coincide in describing translation competence as a set of components (in addition to strictly linguistic knowledge): cultural and subject knowledge, documentation and transfer ability, etc. Nevertheless, only a few include the strategic component[7] and none mention the psycho-physiological component.[8] On the other hand, most of proposals are simply lists of characteristics that define the translator, and do not suggest how these components are related to each other or if there are hierarchies amongst them. Furthermore, none have been validated empirically, i.e. data was not collected and analysed within the framework of a structured research project.

As far as we know, only two studies have attempted an empirical approach to research into translation competence as a whole: Lowe (1987) and Stansfield, Scott and Kenyon (1992). However, as Orozco (2000: 113ff.) points out, Lowe's study is, in fact, a proposal of the elements that indicate levels of translation competence, not an empirical study. According to Orozco, the work of Stansfield, Scott and Kenyon (1992), is the only real empirical-experimental study of translation competence. The instrument they created, called *Spanish into English Verbatim Translation Exam* (SEVTE), was validated by reliability and validity tests. However, the authors themselves indicate that the results cannot be generalised, given the limitations of the sample (7 FBI employees).

As far as the acquisition of translation competence is concerned, very few proposals have been made.[9] On the other hand, although some empirical studies have been carried out to compare the performance of professional translators and that of students of translation,[10] no longitudinal study has yet been carried out to monitor the acquisition of translation competence as a whole.

3. Empirical research on written translation in Translation Studies.

Empirical research into written translation first began in the 1980s.[11] Although these studies do not focus on translation competence as a whole, some of them approach partial aspects that cast light on some of the elements that make up translation competence. For example, there have been studies of the translator's linguistic knowledge (Mondhal & Jensen 1992), linguistic and extra-linguistic knowledge (Tirkkonen-Condit 1992; Dancette 1995; Alves 1996), extra-linguistic knowledge (Dancette 1994, 1997); abilities and aptitudes, such as creativity, emotional qualities and attention-span (Kussmaul 1991, 1995, 1997; Tirkkonen-Condit & Laukkanen 1996); documentation (Atkins & Varantola 1997; Livbjerg & Mees 1999); strategies (Krings 1986; Lörscher 1991, 1992, 1993; Kiraly 1995).

The 1998 model of translation competence: A holistic model

The translation competence models that have been proposed in Translation Studies are not firmly based on validated empirical research that provide the data needed to describe the components of translation competence and the connections between the components. Therefore, the PACTE group's first objective is to provide this research.

Our 1998 holistic model of translation competence (see PACTE 2000) drew on the contributions mentioned above. A distinction is made between competence (the underlying system of knowledge) and performance (translating). It is postulated that translation competence is qualitatively different from bilingual competence, the latter being one of the several components that make up translation competence and that these components are inter-related and there are hierarchies amongst them.

Furthermore, translation competence is considered to be expert knowledge and it is primarily procedural knowledge, where strategies play a very important role and most processes are automatic. Consequently, and taking into account the results of the empirical studies in written translation mentioned above, two components were added to the model: the strategic and the psycho-physiological.

Thus, the basic premises of the model were:

1. Translation competence is qualitatively different from bilingual competence;
2. Translation competence is the underlying system of knowledge needed to translate;

3. Translation competence is an expert knowledge and, like all expert knowledge, comprises declarative and procedural knowledge; the latter is predominant;

4. Translation competence is made up of a system of sub-competencies that are inter-related, hierarchical and that these relationships are subject to variations;

5. The sub-competencies of translation competence are considered to be: a language sub-competence in two languages; an extra-linguistic sub-competence; an instrumental/professional sub-competence; a psycho-physiological sub-competence; a transfer sub-competence; and a strategic sub-competence.

The language sub-competence was defined as the underlying system of knowledge and abilities necessary for linguistic communication in both languages. The extra-linguistic sub-competence was defined as implicit or explicit knowledge about the world in general and specific areas of knowledge: knowledge about translation (its ruling premises: types of translation unit, the processes required, etc); bicultural knowledge; encyclopaedic knowledge and subject knowledge (in specific areas). The instrumental/professional sub-competence was defined as the knowledge and abilities associated with the practice of professional translation: knowledge and use of all kinds of documentation sources; knowledge and use of new technologies; knowledge of the work market and the profession (prices, types of briefs, etc.). The psycho-physiological sub-competence was defined as the ability to use psychomotor, cognitive and attitudinal resources.

In this model, the transfer sub-competence was the central competence that integrates all the others. It was defined as the ability to complete the transfer process from the source text to the target text, that is, to understand the source text and re-express it in the target language, taking into account the purpose of the translation and the characteristics of the receptor.

The strategic sub-competence included all the individual procedures, conscious and unconscious, verbal and non-verbal, used to solve the problems encountered during the translation process. This sub-competence plays an essential role in relation to all the others, because it is used to detect problems, take decisions, and make up for errors or weaknesses in the other sub-competencies.

All these sub-competencies interact to make up translation competence and they are integrated in every translation act, establishing inter-relations, hierarchies and variations. The inter-relations are controlled by the strategic sub-competence, because its role is to monitor and compensate for the other

sub-competencies, as it makes up for weaknesses and solves problems. In the 1998 model we considered that transfer competence plays a central role in the hierarchy and integrates the other sub-competencies.

Variations in translation competence occur in relation to: directionality (direct or inverse translation); language combinations; specialisation (technical, legal, literary, etc.); the translator's experience or the translation context (translation brief, time available, etc.). Thus, for example, in inverse translation the instrumental/professional sub-competence gains importance; the strategies used by the translator vary according to the distance between the language pairs used in the translation; in each translation speciality greater importance will be given to different psychological abilities (logical reasoning in technical translation, creativity in literary translation); a greater degree of automation may be expected when the translator is very experienced; the translation context (translation brief, time, etc.) may require a certain sub-competence to be activated (instrumental/professional, psycho-physiological, etc.).

A dynamic model of translation competence acquisition

If few studies of translation competence exist, there are even fewer of translation competence acquisition. There are some relevant studies in other disciplines, but existing translation studies are only based on observation and experience, and there are no empirical-experimental studies based on representative samples. Although there are a few empirical studies that have compared students' performance with that of the professional translator (Jääskeläinen 1987, 1989; Tirkkonen-Condit 1990; Jääskeläinen & Tirkkonen-Condit 1991; Seguinot 1991, etc.), no study has been made of the process of translation competence acquisition as a whole. As stated above, PACTE's final aim is empirical-experimental research into translation competence acquisition.

The PACTE model developed in 1998 (see PACTE 2000) includes insights from research into the learning process and postulates that translation competence acquisition is a process of restructuring and developing sub-competencies of translation competence. Therefore, translation competence acquisition is defined as:

1. A dynamic, spiral process that, like all learning processes, evolves from novice knowledge (pre-translation competence) to expert knowledge (translation competence); it requires learning competence (learning strategies) and during the process both declarative and procedural types of knowledge are integrated, developed and restructured.

2. A process in which the development of procedural knowledge and, consequently, of the strategic sub-competence are essential.
3. A process in which the translation competence sub-competencies are developed and restructured.

In the process of acquiring sub-competencies there are also relations, hierarchies and variations. Thus, in the acquisition of translation competence, the sub-competencies: (1) are inter-related and compensate for each other; (2) do not always develop in parallel; (3) are organised hierarchically; (4) variations occur in relation to translation direction, language combinations, specialisation and the learning context. Therefore, the translation competence acquisition process may not be parallel for direct and inverse translation. Furthermore, depending on the language combinations, the process may be more or less rapid, or, depending on the translation speciality (legal, literary translation, etc.) one sub-competence may be more important than another. On the other hand, the learning context (formal training, self-learning, etc.) influences the acquisition process, as does the methodology used by teachers.

Research design

Our research design includes several different types of tests with different groups of subjects (PACTE 2001, 2002a, 2002b; Beeby 2000). Six language pairs are used: English-Spanish; German-Spanish; French-Spanish; English-Catalan; German-Catalan; French-Catalan.

There are several reasons for choosing these combinations:

1. We want to experiment with several language combinations to observe whether translation competence functions in the same way in them all. Above all, we are interested in comparing language combinations where the languages are close to each other (French-Spanish; French-Catalan) with other combinations where the languages are more distant (English-Spanish; German-Spanish; English-Catalan; German-Catalan).
2. These six combinations are the most common in the professional translation market in Catalunya; the inclusion of two A languages (Spanish and Catalan) reflects the bilingual, bicultural reality of Catalunya.
3. English, French and German are the three B languages taught in our Faculty and they are used in translation classes in both directions (direct and inverse).

Subjects, instruments and experimental tasks

Two types of subjects are used to study translation competence: professional translators (experimental group 1) and "bilingual" subjects who do not translate (experimental group 2). A questionnaire prepared for each group is used to form homogeneous, representative groups and exclude subjects that might introduce extraneous variables. This is to guarantee that the experimental subjects really belong to the samples that are the object of study (professional translators and bilingual subjects). For the groups to be comparable, certain features or characteristics that could distort the results have to be controlled (e.g., age, specialisation, length of work experience).

Three types of tests are carried out: exploratory studies, pilot tests and experiments. The exploratory studies are observational and their purpose is to improve the instruments and the hypotheses. The purpose of the pilot tests is to test the improved instruments. Both are used to prepare the experiment.

Several different instruments have been designed: a commercial software programme (PROXY), protocol texts for translation into and out of the foreign language, questionnaires, a direct observation chart to observe subjects' activities while translating, and retrospective and guided Think-Aloud-Protocols (TAPs). Simultaneous TAPs are not used, not only because they make the situation very artificial, but also because they may change the process, as the TRAP group in Copenhagen suggests: "One of the problems in relation to TAP's is whether it is possible to engage in two complicated actions of a similar nature (namely translating and thinking aloud) simultaneously, and whether one influences the other. Having to think aloud during the translation process may change the process, which obviously affects the quality of the data." (Hansen et al. 1998: 62)

PROXY is a user monitoring programme, i.e. a programme that permits the remote control of workstations and users connected to the same network, that is able to record and monitor subjects' activities during the translation process, in real time.[12] The use of PROXY is most useful in our study, particularly in relation to ecological validity (i.e., to guarantee that the experiment reflects the real situation).[13] The advantages its offers are as follows: (1) it is compatible with Microsoft Windows, so that subjects can work with the text processor they are most familiar with; (2) it can be used in conjunction with other Windows applications, so that subjects can carry out information searches on the Internet or in on-line dictionaries and CD-Roms; (3) all subjects' activities may be viewed and recorded in real time and viewed later at different speeds (as if it were a video recording); (4) all subjects' activities during the transla-

tion process can be recorded and the data obtained cross-referenced with data collected using other instruments (direct observation charts, questionnaires, TAPs, etc.); (5) subjects are unaware of the fact that their activities are being monitored and recorded.

Protocol texts have been selected for subjects to translate, one into and one out of the foreign language. The texts included indicators of all the translation competence sub-competencies, except for the strategic and transfer sub-competencies. These two cannot be observed directly in the texts, but only during the experimental tasks through direct observation and recording by PROXY. Therefore, following our translation competence model, the texts include indicators of: language problems (lexical, grammatical and textual); extra-linguistic problems (encyclopaedic, cultural, subject-matter); instrumental/professional problems (related to the translation brief, documentation difficulties related to the number of queries or the unusual nature of the information search); psycho-physiological problems (related to coherence, style, etc., where creativity, logical reasoning, etc., have to be activated to produce functional and dynamic equivalencies).

Different types of questionnaires are used. The first, (Questionnaire I), is designed to obtain information about the subjects (translation training, professional experience, type of texts translated, etc.) and their concept of translation. The second, (Questionnaire II), is used to obtain information from the subjects about the protocol texts they have translated (the problems encountered and the strategies used to solve them).

The experimental tasks are the same for all the tests and consist of:

1. the completion of a questionnaire to obtain information about the subject (Questionnaire I);
2. the translation of two texts, one into and one out of the foreign language, monitored and recorded by PROXY;
3. the completion of a questionnaire (Questionnaire II) after translating each of the two texts;
4. the completion of a retrospective, guided TAP; whilst viewing the recording of the subject's translation on the screen the researcher tries to recover as much information as possible from the translator about his/her cognitive behaviour and asks for clarification when necessary (the reasons for certain decisions, pauses, corrections, etc.).

As the subjects translate each text, any activities that cannot be recorded by PROXY are observed, without the subject realising, and recorded in observation charts (consultation of printed materials, reading of the source or target

texts, etc.). The target texts produced by the subjects will be used to build an electronic corpus of texts and this information will be cross-referenced with the data gathered from the experiment.

In the study of translation competence acquisition, the experimental subjects are translation students and the group of professional translators acts as the reference group. The same types of tests are carried out over a period of two years, starting with translation students at the beginning of their training, and using the same experimental tasks and instruments as described above, using a repeated measurement experiment design.

Current stage of research: Exploratory studies in Translation Competence

The conceptual stage of our study has been completed with the construction of a holistic model of Translation Competence and a dynamic model of Translation Competence Acquisition, which were used to deduce theoretical and working hypotheses. Furthermore, the methodological stage has been initiated by designing the research, measuring instruments and experimental tasks.

Our research is now focused on the empirical study of translation competence. In preparation for the final experiment, two exploratory tests were carried out during the year 2000. In the first, subjects were members of the PACTE research group. In the second, subjects were six professional translators working in three language combinations (English-Spanish; German-Spanish; French-Spanish), each language combination was represented by two translators. In both exploratory tests, instruments and experimental tasks designed for use in the final experiment were used.

These exploratory tests were observational and the aims were:[14] (1) to test the holistic model of translation competence developed in 1998 (the sub-competencies involved and the relationship between each); (2) to test and improve the measuring instruments and the experimental tasks to be used in the final experiment; (3) to establish our empirical hypotheses; (4) to select variables. The results obtained from these tests are currently being analysed and our findings to date are now being used to improve our measuring instruments and our model of translation competence.

Findings obtained from the different instruments used in these tests were collated and cross-referenced using custom-designed charts. Although an exhaustive analysis has yet to be made of the results obtained, it has become clear to the Group that certain changes must be made in the measuring instruments used, and the 1998 model of translation competence should be revised.[15]

Our tests have confirmed that the software program PROXY is a particularly useful instrument for observing the translation process, and the experimental tasks designed by the Group are appropriate for studying the cognitive dimensions of translation competence. Although more detailed analysis is required, it would appear that some improvements are, nevertheless, required in the measuring instruments developed in relation to the texts used, the indicators of sub-competencies and the questionnaires. Given that this article focuses on the most important issues that have led us to question the 1998 model of translation competence, the modifications made to the instruments are not included (see PACTE 2002a).

Outcome of the exploratory test in Translation Competence

Our exploratory tests have enabled us to observe, and more precisely define, a much wider range of activities carried out by subjects during the translation process and have shown the need to modify our 1998 translation competence model.

The expert translator's observable activities

One of the most significant results of the exploratory tests is a catalogue of activities based on observation of the translator at work. These activities were detected through direct observation (using the direct observation chart) and through viewing the PROXY recordings (see Table 1):

1. Activities detected through direct observation: first-time reading of the source text (before writing), re-reading of the source text, revising the target text, underlining, making notes, comparing source text and target text and consultation of printed materials.
2. Activities detected through viewing the PROXY recordings: immediate solution to a translation problem; non-immediate solution to a translation problem (after a pause, consultation, etc.); pause (longer than 5 seconds); postponed solution; solution of a postponed solution; temporary solution; final solution of a temporary solution; on-line consultation; use of new technologies (Internet, text processing); and corrections (lexical items, grammar, cohesion, coherence, etc.).

In order to investigate these activities we need to measure in the experiment: (1) the time spent on each activity, to know which activities take up most time

Table 1. Catalogue of the expert translator's observable activities

DIRECT OBSERVATION	RECORDED IN PROXY
First reading of the source text	Immediate solution
Re-reading of the source text	Not immediate solution
Revising the target text	Pause (longer than 5 seconds)
Underlining	Postponed solution
Making notes	Solution of a postponed solution
Comparing source text and target text	Provisional solution
Consultation of printed material	Solution of a provisional solution
	Text processing
	Consultation of electronic material
	Corrections

in the expert translation process; (2) the number of times each activity takes place, to know which are most commonly used by the expert translator; (3) the moment they take place in the translation process, so as to be able to follow the development of the process (movements backwards and forwards in the text). Furthermore, we need to describe the characteristics of these activities: Which elements are underlined and marked? What happens in the pauses? What are the steps taken to reach a *not immediate solution*? What happens between a *postponed solution* and its solution? What happens between a *provisional solution* and its solution? What kinds of corrections are carried out? Finally, we have to relate these activities to the translation competence sub-competencies.

Several characteristics of these activities indicate the complexity of the expert translator's behaviour, which is something we should study in our experiment.

Observable and non-observable behaviour
The activities detected in the expert translator's behaviour are observable activities. However, translation competence as a whole is a construct that cannot be observed directly. We can observe behaviour (the catalogued activities), but not complex mental operations, which can only be accessed indirectly through the activities.

Therefore, the catalogued activities are the translator's directly observable behaviour, the result of cognitive procedures that cannot be observed directly. Nevertheless, we can access them indirectly using different instruments.[16] Thus, the TAPs and the questionnaires should help us to collect information about this cognitive behaviour that cannot be observed by direct observation or the PROXY recordings.

Automatic activities
We have observed that these activities may occur immediately (automatically) or not immediately (requiring more time and intermediate stages). Our hypothesis is that the expert translator takes more immediate decisions that lead to a positive outcome than the trainee translator, because the expert translator already possesses expert knowledge and this, like all expert knowledge, is largely automatic. Thus, in the experiment, attention should be paid to immediate positive solutions of an element in the source text, which should be more frequent amongst expert translators than trainee translators.

The questionnaires and the retrospective guided TAP that will be used in the experiment should provide information about how conscious the translator is about these more automatic activities and show that the translator is not always conscious of this type of cognitive procedure.

Problem solving and decision making
Interruptions in the process (pause) and elements that cause the translator to delay taking a decision (postponed solution) or to take a provisional decision (provisional solution) are the best indicators of the existence of a problem for the translator. They mark the activation of sub-competencies and the application of strategies (consultation of documentary sources, reconsideration of the context, mnemonic aids, etc.) that help the translator to take decisions. The translator takes decisions that affect the translation at all levels: global aspects (work plan, etc.); macro-structural elements (corrections that affect the coherence of the target text); micro-structural elements (corrections related to micro-units of translation: lexical, grammatical, etc.). All these questions will have to be observed in detail in the experiment.

Combinations and chains of activities
We have observed that when solving a translation problem, the translator combines activities, and links together several activities, depending on the particular problem. This indicates the crucial role of the strategic sub-competence in controlling the whole process. Thus, in the experiment, we will have to observe how these activities are combined and the hierarchical relationships amongst them.

The need to redefine the 1998 Translation Competence model

When attempting to establish links between subjects' activities and specific translation competencies, as a first step towards defining our empirical hy-

potheses (i.e. what we wish to observe and contrast in our experiment), and looking for ways to measure each sub-competence, we have found it necessary to revise the definition and functions of each of the translation sub-competencies included in our 1998 model of Translation Competence.

The modifications now being considered are related above all to the following points.

1. It would seem that the transfer sub-competence is not just one sub-competence of the whole group of sub-competencies that make up translation competence. All bilinguals possess a rudimentary transfer ability, the *natural translation* ability described by Harris and Sherwood (1978). The differences between this ability and expert translation competence is due to the interaction amongst the other sub-competencies, and in particular, to the role played by the strategic sub-competence. Therefore, it would seem that this special transfer capacity of the expert translator is the combination of all the sub-competencies, i.e. translation competence: the ability to carry out the transfer process from the source text to the production of the target text in function of the receptor's needs and the purpose of the translation. This redefinition of transfer competence obliges us to modify the characteristics of the linguistic and the strategic sub-competencies.

2. Thus, there are two important aspects to be considered in relation to the linguistic sub-competence: the fact that the expert translator as a bilingual has the ability to change from one language to another, but also, that the translator is able to separate the two languages that are in contact.

3. It is becoming increasingly clear that the strategic sub-competence plays a crucial role in translation competence since it is used to: plan the translation project; activate, monitor and compensate for shortcomings in other translation sub-competencies; detect translation problems; apply translation strategies; monitor and evaluate both the translation process and the partial results obtained in relation to the intended target text, etc.

4. Given its importance within translation competence, knowledge about translation, which had previously been ascribed to extra-linguistic sub-competence and instrumental/professional sub-competence, would now appear to constitute a specific sub-competence Data collection would be facilitated.

5. Finally, the psycho-physiological sub-competence would appear to warrant a status somewhat different from that of other sub-competencies since it forms an integral part of all expert knowledge. Rather than 'sub-

competence' it would perhaps be more appropriate to speak of psycho-physiological 'components'.

On the other hand, we have realised that if translation competence is expert knowledge, then it should be defined in terms of declarative and procedural knowledge.

Redefinition of the holistic translation competence model

As a result of the above considerations, we have adjusted our definition of translation competence and its sub-competencies as follows.

Translation competence is the underlying system of knowledge needed to translate. It includes declarative and procedural knowledge, but the procedural knowledge is predominant. It consists of the ability to carry out the transfer process from the comprehension of the source text to the re-expression of the target text, taking into account the purpose of the translation and the characteristics of the target text readers. It is made up of five sub-competencies (bilingual, extra-linguistic, knowledge about translation, instrumental and strategic) and it activates a series of psycho-physiological mechanisms.

The bilingual sub-competence. Predominantly procedural knowledge needed to communicate in two languages. It includes the specific feature of interference control when alternating between the two languages. It is made up of pragmatic, socio-linguistic, textual, grammatical and lexical knowledge in the two languages.

Pragmatic knowledge is knowledge of the pragmatic conventions needed to carry out language acts that are acceptable in a given context; they make it possible to use language to express and understand linguistic functions and speech acts. Socio-linguistic knowledge is knowledge of the socio-linguistic conventions needed to carry out language acts that are acceptable in a given context; this includes knowledge of language registers (variations according to field, mode and tenor) and of dialects (variations according to geographical, social and temporal dialects). Textual knowledge is knowledge of texture (coherence and cohesion mechanisms) and of different genres with their respective conventions (structure, language features, etc.). Grammatical-lexical knowledge is knowledge of vocabulary, morphology, syntax and phonology/graphology.

Extra-linguistic sub-competence. Predominantly declarative knowledge, both implicit and explicit, about the world in general and special areas. It includes: (1) bicultural knowledge (about the source and target cultures); (2)

encyclopaedic knowledge (about the world in general); (3) subject knowledge (in special areas).

Knowledge about translation sub-competence.   Predominantly declarative knowledge, both implicit and explicit, about what translation is and aspects of the profession. It includes: (1) knowledge about how translation functions: types of translation units, processes required, methods and procedures used (strategies and techniques), and types of problems; (2) knowledge related to professional translation practice: knowledge of the work market (different types of briefs, clients and audiences, etc.).[17]

Instrumental sub-competence.   Predominantly procedural knowledge related to the use of documentation sources and information and communication technologies applied to translation: dictionaries of all kinds, encyclopaedias, grammars, style books, parallel texts, electronic corpora, searchers, etc.

Strategic sub-competence.   Procedural knowledge to guarantee the efficiency of the translation process and solve the problems encountered. This is an essential sub-competence that affects all the others and causes inter-relations amongst them because it controls the translation process. Its functions are: (1) to plan the process and carry out the translation project (choice of the most adequate method); (2) to evaluate the process and the partial results obtained in relation to the final purpose; (3) to activate the different sub-competencies and compensate for deficiencies in them; (4) to identify translation problems and apply procedures to solve them.

Psycho-physiological components.   Different types of cognitive and attitudinal components and psycho-motor mechanisms. They include: (1) cognitive components such as memory, perception, attention and emotion; (2) attitudinal aspects such as intellectual curiosity, perseverance, rigour, critical spirit, knowledge of and confidence in one's own abilities, the ability to measure one's own abilities, motivation, etc.; (3) abilities such as creativity, logical reasoning, analysis and synthesis, etc.

These considerations are illustrated in the following Figure 1.

Conclusion

The experience gained from the research carried out so far has led us to redefine the sub-competencies of the 1998 translation competence model and adjust their functions. It has become clear that translation competence is qualitatively different from bilingual competence and that it is expert knowledge in which procedural knowledge is predominant. Furthermore, it has become increas-
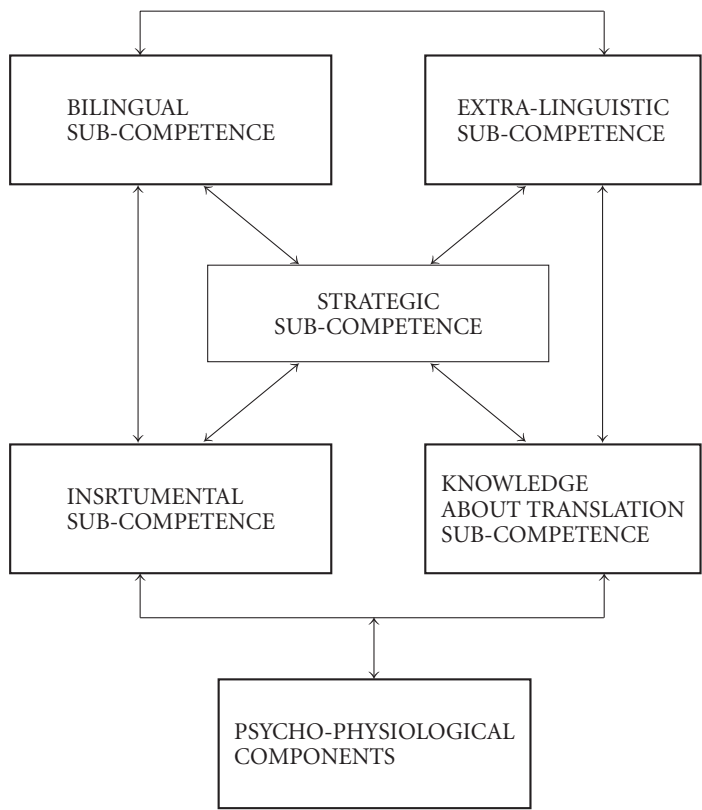
Figure 1. Model of translation competence revisited

ingly clear that translation competence is made up of a set of sub-competencies that are inter-related and hierarchic, with the strategic sub-competence occupying a dominant position.

Once we have concluded the analysis of the data obtained from our exploratory tests, the next stage of our research will be to redefine our theoretical and working hypotheses (see PACTE 2001), establish our empirical hypotheses and select the variables to be observed in our final experiment.

Obviously, the revised model presented here is still subject to modifications, because the definition of our hypotheses may lead to the need for certain adjustments. Only when we have completed the experiment will we have the necessary data to validate the model and reach a final version.

Although ours is an extended research project, and not without its difficulties, we believe an attempt must be made to investigate the acquisition

of translation competence empirically. We are convinced that knowing more about how translation competence functions and how it is acquired will lead to better curricular designs for training professional translators. This is our final goal.

Notes

1. See, for example, Nord (1997).

2. See, for example, Wilss (1988, 1996).

3. For our model, the most relevant studies of communicative competence are those by Hymes (1971), Canale and Swain (1980), Canale (1983), Widdowson (1989), Spolsky (1989), Bachman (1990), etc.

4. Also important are the studies of expert knowledge and learning processes by Ryle (1949), Anderson (1983), Dreyfus and Dreyfus (1986), Lesgold and Glaser (1989), Pozo and Postigo (1993), Pozo (1996), Ellis (1997), Puente Ferreras (1998), etc.

5. This distinction is based on the difference established by Ryle (1949) between *knowing what* and *knowing how*, i.e. the procedures by which this knowledge is acquired.

6. Proposals related to the functioning of translation competence were made by authors such as Lowe (1987), Bell (1991), Hewson y Martin (1991), Nord (1992), Pym (1992), Presas (1996), Hurtado Albir (1996a, 1996b), Beeby (1996), Hansen (1997), Hatim and Mason (1997), etc. Other proposals made after the beginning of the PACTE project are: Risku (1998), Campbell (1998), Neubert (2000), Kelly (2002), etc.

7. See. Hurtado (1996b), Hansen (1997), etc.

8. This is only included in Kelly (2002).

9. Proposals related to the acquisition of translation competence include those by Harris (1973, 1977, 1980), Harris and Sherwood (1978), Toury (1995), Shreve (1997) and Chesterman (1997).

10. See, for example, Jääskeläinen (1987, 1989), Tirkkonen-Condit (1990), Jääskeläinen and Tirkkonen-Condit (1991), Kiraly (1995), Lorenzo (1999), etc. Seguinot (1991) is an interesting longitudinal study of the translation strategies used by students, based on the results of translation tests given over a period of six years, at the beginning and end of their training.

11. For a review of empirical-experimental research in translation, see Orozco 2000: 48–49 and Orozco 2001.

12. The use of PROXY for research in translation was proposed by W. Neunzig and presented in his doctoral thesis (Neunzig 2001).

13. The criteria of ecological validity, as defined in the philosophy of science, postulates that all experiments should reflect a real situation, and avoid artificiality. It is perhaps one of the most difficult problems in any laboratory experiment. It is obvious that our type of research is by definition "artificial", because it is difficult to design a situation in which the subjects,

e.g., the translators, are not influenced by the context or by the mere fact that they know they are participating in an experiment. We do not use the aforementioned *think aloud protocols* and video recordings to collect data because they lack ecological validity.

14. See PACTE 2002a for a detailed description of the instruments and esperimental tasks.

15. These findings were presented in the *II Encontro Internacional de Tradutores* (Belo Horizonte, 23–27 July, 2001) and in the *Third International EST Congress* (Copenhagen, 30 August–1 September, 2001).

16. See, for example, in this volume, the work of Alves and Gonçalves; Hansen; Livbjerg and Mees, that shed light on the translator's cognitive processes, using TAPs, the Translog software, etc.

17. Other aspects intervene, such as: knowledge of translation associations, tarifs, taxes, etc.

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Monitoring the process

Effects of think aloud on translation speed, revision, and segmentation

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Four MA translation students and five expert translators translated two texts from Danish into English and two from English into Danish. In each language direction, one task was performed while thinking aloud and one without thinking aloud. All tasks were performed on a computer, and all keystrokes were logged with *Translog*. The aim was to determine what influence, if any, the think-aloud condition might have on translation speed, on the amount of revision undertaken, and on pause-defined segmentation. It was expected that thinking aloud might slow down the process of translation, but that it would have no effect on revision or on segmentation. In both groups, significant effects were found on speed. Thinking aloud delayed translation by about 25%. No significant effects on revision were found. However, contrary to expectation, significant effects on segmentation were discovered. The think-aloud condition forced both groups of translators to process text in smaller segments.

Introduction

The main method for investigating the cognitive information processing involved in translating has been the introspective 'think-aloud' method as described by Ericsson & Simon (1984). There is another, more mechanical method of 'tapping', 'mapping', or 'probing' the process of translation (Hansen 1999; Jääskeläinen 1999; Tirkkonen-Condit & Jääskeläinen 2000), however. Real-time keystroke logging offers an additional and complementary method of investigating the process based on the keyboard behaviour of a translator (Jakobsen 1998, 1999; Jakobsen & Schou 1999).

With the advent and spread of personal computers, most translations have come to be typed on a keyboard. As a result, translators' keyboard skills have developed to the level where (in some cases at least) typing is almost as

immediate and automatic as speech. In any case, editing has become so easy that most translators now prefer to get ideas into type immediately rather than finish processing whole clauses or sentences before starting to type them. An effect of this is that, when logged, a translator's keystrokes constitute what might be called a 'type-along protocol' or even a 'type-along think-aloud protocol', with information about first impulses, false starts, revisions, etc., much like that which is elicited in think-aloud protocols.

Keystroke logging is no substitute for the information that can be elicited through think aloud, however, but the combination of think aloud (TA) with keystroke logging creates a powerful method which makes it possible to triangulate observations and formulate stronger hypotheses about translation (Alves 2001). If one data source dries up at a certain point, data may be available in the other, and the two methods will complement each other. If data from two different sources can be analysed as converging, any finding will be stronger than if based on one data source only.

With two methods at our disposal, one method can also be used to validate (or invalidate) the other, which is what the present paper aims to do. It proposes to examine one of the central claims about think aloud, viz. that vocalisation of orally encoded information makes no additional demands on processing time or capacity. In the words of Ericsson & Simon (1993: 62):

> [...] our fundamental assumption is that, when the CP [the central processor] attends to or activates a structure in memory that is orally encoded, then this structure can at the same time be vocalized overtly without making additional demands on processing time or capacity. At any time when the contents of STM [short-term memory] are words (i.e., are orally encoded), we can speak those words without interference from or with the ongoing processes.

The memory structures activated in translation are all orally encoded (in Ericsson & Simon's sense). Ericsson & Simon's fundamental assumption therefore appears to apply unrestrictedly to translation. Part of the fascination of the assumption is that to many people it is counter-intuitive. Intuitively, one is inclined to assume that thinking aloud adds to the cognitive stress a translator is working under, and that the translation process must therefore somehow be affected (negatively) by it. On the face of things, it seems unlikely that it is possible to verbalise, i.e. to open up an additional, concurrent channel of articulation, without delaying or otherwise affecting the main cognitive process going on, viz. the process of translation.

Ericsson & Simon acknowledge that in some instances thinking aloud may have a delaying effect on the main cognitive process (1993: 77):

> Our model (…) predicts that overt verbalization under thinking-aloud in-
> structions will not affect the speed of performance unless the verbalizations
> have to be queued.

No other effect of think aloud on the main cognitive process is predicted.

In order to test Ericsson & Simon's claim, it was decided to measure the effect of the think-aloud condition first of all on translation speed, but since a delaying effect could be attributed to verbalisations having had to be queued, it was also decided to look for possible effects on the manner of task execution (by examining the amount of revision undertaken) and for effects on processing capacity (by counting the number of text production segments per source text unit). If no effects, negative or positive, were found, Ericsson & Simon's hypothesis would come out strengthened. If effects were found, this would by no means invalidate the think-aloud method, but would make it relevant to determine how strong the effects were on translation, in what areas they operated, and to what extent they could be said to affect the translation process, negatively or positively.

Experiment design

Nine subjects, four semi-professional translators (MA translation students in their final (fifth) university year) and five expert translators with at least two years of postgraduate professional experience, each translated four short texts after a brief warm-up session.

The warm-up session was intended to make subjects familiar with the *Translog* interface and the general experimental situation. It included brief instruction in thinking aloud and a chance to practise think aloud while translating.

After the briefing and warm-up exercise, subjects were asked to translate four texts (in random order), two from Danish into English, and two from English into Danish. The two Danish source texts (Texts 1 and 2 in the tables) were 367 and 522 characters long (including spaces). The two English source texts (Texts 3 and 4) were longer (760 and 1001 characters) as it was expected that translation into L1 (Danish) would be considerably faster than translation into L2 (English). All texts were displayed in full in *Translog*. Subjects were asked to work at their normal pace. They were told that the experiment would probably last between one and two hours, but no time limit was set.

Experiment sessions in fact generally lasted between one and two hours for all four translation tasks.

Subjects had access to various bilingual dictionaries and were allowed to access Internet information. L1 to L2 translation was included because it would be interesting to explore if verbalisation (presumably mostly in L1) would affect L2 target text production differently from L1 target text production.

In each language direction, one text was translated with concurrent think aloud, one without. Think-aloud verbalisations were recorded on audiotape, and all keystrokes (except keystrokes for operations outside *Translog*, such as Internet navigation) were logged in *Translog* together with real-time information about each keystroke.

All translators stated that Danish was their strongest language (L1), but the fact that English was one of the professionals' mother tongue came out quite clearly in the data (and slightly blurred the overall picture in some respects).

Since the initial analysis (the analysis reported in the present paper) was based on quantitative data only, information from the audiotapes was not used here. Furthermore, the quantitative analysis was based on counts of entire translation tasks, not separately e.g. on pre-drafting, drafting, and post-drafting phases.

Predictions

It was expected that with regard to speed:

1. Translation would be slower with TA than without TA for both groups and both for L2 to L1 and L1 to L2 translation.
2. Expert translators would accomplish tasks faster than translation students – regardless of language direction and think-aloud condition.
3. L1 to L2 translation would be slower than L2 to L1 translation for both groups, regardless of TA condition. L1 to L2 translation with TA was expected to be particularly slow because verbalisation in L1 was believed to inhibit L2 target text production.

With regard to revision, it was expected that:

4. Regardless of TA condition, more revision would be undertaken in L1 to L2 translation than in L2 to L1 since both groups of translators would be struggling more to find appropriate translation equivalents when working into L2 than when working into L1.

5. The TA condition (following Ericsson & Simon) would have no effect on the amount of revision.

With regard to segmentation, it was expected that:

6. Segments would vary according to language direction such that there would be relatively more process segments in L1 to L2 translation than in L2 to L1 translation, where subjects would more often succeed in finding phrase- and clause-length idiomatic translations.
7. That (following Ericsson & Simon) the TA condition would not have an effect on the relative number of segments.

Effects on speed

Group of semi-professionals

In the group of semi-professionals a clear effect of think aloud on speed (interpreted either as the total number of keystrokes or the total number of text production characters typed per time unit) was found. The value of the 'Duration Min:sec' variable was the total time in minutes and seconds a subject took to perform a task. The value of 'Total keys/min' was the total number of keystrokes per minute, and the value of 'Text prod keys/min' was the number of text production characters typed per minute (including spaces and carriage returns, but excluding deletion and cursor navigation keystrokes).

By averaging the per-minute figures in Table 1 across texts, the following figures for speed with and without TA were found (Table 2).

For the semi-professional group as a whole, the think-aloud condition reduced the number of total keys per time unit by 20% (63 to 50.4) and the number of text production keystrokes per time unit by 22.3% (48.1 to 37.4).

When looked at individually, the subjects displayed considerable variation, ranging from a low of 24 text production keystrokes per minute to a high of 60.5. All subjects produced less text per minute with TA than without, but they appeared to be unequally affected by the TA condition. Subject 2 produced 38% less text with TA, whereas subject 3's text production volume per minute was virtually unaffected by the TA condition.

Table 1. Raw figures for task duration and keystrokes in the group of semi-professionals (subjects 1–4)

Subject	Text	TA condition	Language direction	Duration Min:sec	Total keystrokes	Text prod keys	Total keys/min	Text prod keys/min
1	1	With TA	L1→L2	19:51	560	461	28	23
2	1	With TA	L1→L2	17:48	863	631	48	35
3	1	With TA	L1→L2	13:55	1044	726	75	52
4	1	With TA	L1→L2	19:23	601	498	31	26
			Average	17:44	767.0	579	45.5	34.0
1	2	No TA	L1→L2	16:47	704	632	42	38
2	2	No TA	L1→L2	12:46	937	693	73	54
3	2	No TA	L1→L2	9:36	710	550	74	57
4	2	No TA	L1→L2	25:47	1078	759	42	29
			Average	16:14	857.3	658.0	57.8	44.5
1	3	No TA	L2→L1	24:46	1062	822	43	33
2	3	No TA	L2→L1	15:37	1278	1053	82	67
3	3	No TA	L2→L1	14:32	1214	916	84	63
4	3	No TA	L2→L1	24:29	1556	1078	64	44
			Average	19:51	1277.5	967.3	68.3	51.8
1	4	With TA	L2→L1	42:57	1311	1089	31	25
2	4	With TA	L2→L1	41:45	2209	1690	53	40
3	4	With TA	L2→L1	19:20	1524	1245	79	64
4	4	With TA	L2→L1	37:31	2175	1276	58	34
			Average	35:23	1804.8	1325	55.3	40.8

Table 2. Average difference in speed for the group of semi-professionals calculated as the average number of total keystrokes per minute and as the number of text production keystrokes per minute under the two TA conditions.

Subject	Total keys/min With TA:	Total keys/min Without TA:	Text prod keys/min With TA:	Text prod keys/min Without TA:
1	29.5	42.5	24	35.5
2	50.5	77.5	37.5	60.5
3	77	79	58	60
4	44.5	53	30	36.5
Average	50.4	63	37.4	48.1

Group of experts

The group of expert translators translated the same four texts as the semi-professionals. The TA condition for each text was the opposite, i.e. no TA with texts 1 and 4, and with TA during the translation of texts 2 and 3. The language direction remained the same: L1→L2 in texts 1 and 2, and L2→L1 in texts 3 and 4. The corresponding figures obtained in this group were as follows:

Table 3. Raw figures for task duration and keystrokes in the group of expert translators (subjects 5–9).

Subject	Text	TA condition	Duration Min:sec	Total keystrokes	Text prod keys	Total keys/min	Text prod keys/min
5	1	No TA	10:11	638	510	63	50
6	1	No TA	6:45	754	527	112	78
7	1	No TA	15:39	1410	745	90	48
8	1	No TA	6:56	519	442	75	64
9	1	No TA	15:47	597	455	38	29
		Average	11:04	783.6	535.8	75.6	53.8
5	2	With TA	12:05	711	600	59	50
6	2	With TA	16:51	1074	731	64	43
7	2	With TA	29:31	1422	753	48	26
8	2	With TA	13:26	852	678	63	50
9	2	With TA	12:58	750	609	58	47
		Average	16:58	961.8	674.2	58.4	43.2
5	3	With TA	18:21	1120	967	61	53
6	3	With TA	18:59	1524	981	80	52
7	3	With TA	23:32	1972	1143	84	49
8	3	With TA	17:47	1143	965	64	54
9	3	With TA	27:39	1183	956	43	35
		Average	21:16	1388.4	1002.4	66.4	48.6
5	4	No TA	22:02	1474	1277	67	58
6	4	No TA	15:59	1955	1368	122	86
7	4	No TA	26:53	3732	1788	139	66
8	4	No TA	19:36	1697	1396	87	71
9	4	No TA	28:38	2100	1434	73	50
		Average	22:38	2191.6	1452.6	97.6	66.2

Table 4. Average difference in speed for the group of expert translators calculated as the average number of total keystrokes per minute and as the number of text production keystrokes per minute under the two TA conditions.

Subject	Total keys/min With TA:	Total keys/min Without TA:	Text prod keys/min With TA:	Text prod keys/min Without TA:
5	60	65	51.5	54
6	72	117	47.5	82
7	66	114.5	37.5	57
8	63.5	81	52	67.5
9	50.5	55.5	41	39.5
Average	62.4	86.6	45.9	60

Again averaging the per-minute figures across texts, the figures found for speed with and without TA were as shown in Table 4:

Within subject comparison showed that the TA condition was slower for all subjects on the total keystroke count. Again, subjects were very differently affected (range 8%–42%). On the text production count, four of the expert translators were also slower with TA than without (range 5%–42%). Unexpectedly, however, one subject was slightly faster with TA than without (3.6%). (This result was caused by Subject 9's exceptionally slow translation of text 1.)

For the group as a whole, there were 27.9% fewer keystrokes overall (86.6 vs. 62.4) and 23.5% fewer text production keystrokes per minute in the TA condition than without TA (60 vs. 45.9).

Comparison of groups

The speed with which expert translators worked on the tasks, resulted in text production at an average of 60 keystrokes per minute without TA, 46 with TA. The maximum average text production speed achieved in a task was 86 characters per minute. The minimum was 26. (In terms of normal pages, these maximum and minimum figures amount to respectively about 3 pages and 1 page of text per hour.)

The group of semi-professionals produced text a good deal more slowly, their average speed being 48 characters per minute without TA, and only 37 with. The maximum average text production speed achieved in a task was 67 characters per minute. The minimum was 23.

Thus, the first two predictions were borne out by the findings: both groups worked faster without the TA condition (22.3% and 23.5%), and expert

translators worked faster than final-year translation students, 18.6% faster with TA and 19.8% faster without.

Discussion

The difference in text production speed between the group of semi-professionals and the experts was less than expected. Four main factors, two of them affective, may have contributed to slowing down the performance of the experts. First of all, the translation tasks were not routine tasks within the translators' fields of expertise. Secondly, the fact that counts were made across entire tasks may have skewed the difference between the two groups. It is possible that the experts worked faster than is reflected in the overall statistics while drafting their translations, but subsequently spent more time on carefully revising the drafts (cf. Jakobsen 2002). Thirdly, the professionals were very self-conscious (some might say hypersensitive or even slightly paranoid) about the whole situation. They obviously felt they were in an unnatural situation, whereas the translation students were more at ease, more confident, and on the whole also more generous with their verbalisations. Finally, the professionals were very conscious that the experiment might challenge their professional face and therefore wanted to avoid compromising themselves at any cost.

These factors reflect negatively on the ecological validity of the experiment, but the fact remains that under the conditions of the experiment, and disregarding any differences in the quality of task solutions, professional translators produced text only about 20% faster (overall) than final-year translation students.

Effect of language direction

As shown by the figures in Table 1 (column 8: Total keys/min), each of the four semi-professionals worked more slowly towards L2 than towards L1 under the same TA condition. The average (group) difference was 16.4%. By the text production keystroke count (column 9), three of the four subjects worked more slowly in the TA condition (range 14%–30%), but one subject produced 5% more text per minute, bringing the average group difference for text production keystrokes down to 13.9%.

Within subject comparison of the corresponding figures for the group of experts (Table 3) showed that all subjects (except Subject 9 when working in

the TA condition) produced fewer keystrokes per minute when working into L2 than when working into L1 (under the same TA conditions).[1]

For the expert group as a whole, and accepting Subject 9's problematic Danish L1, L1 to L2 translation was 15.5% slower than L2 to L1 translation. The first half of prediction 3 was therefore supported by the findings.

The reasoning behind the second half of the third prediction, that translation into the L2 with TA would be particularly slow, was that subjects were expected to think aloud in their L1 and that thinking aloud in one language while composing a text in another language would cause interference or create a language conflict which would inhibit and delay text production.

In the group of semi-professionals there were 23.6% fewer text production keystrokes with TA into L2 than without, and 8.4% fewer with TA into L2 than with TA into L1. Similarly, in the group of experts there were 19.7% fewer text production keystrokes with TA into L2 than without, and 9.7% fewer with TA into L2 than with TA into L1.

Both think aloud and the L1 to L2 direction delayed text production. The prediction that translation into L2 with TA would be particularly slow was supported by the findings, but it could only be speculated that the delay was caused by a conflict between thinking aloud in L1 and simultaneously producing text in L2.

ANOVA analysis of speed effects[2]

The data for the speed variable were analysed using a $2 \times 2 \times 2$ analysis of variance.

The three factors were expertise (semi-professional vs. expert), think-aloud accompanying the translation (with vs. without), and the direction of the translation (L1→L2 or L2→L1).

The analysis showed that two of the three factors had significant main effects.

The main effect of expertise on speed did not reach significance (42.75 for semi-professionals vs. 52.95 for experts, $F(1,7)=1.72$, ns). However, the speed measure was higher without than with think-aloud (54.06 vs. 41.63, $F(1,7)=8.97$, $p=.02$), and was higher for translating into L1 than translating into L2 (51.82 vs. 43.87, $F(1,7)=14.16$, $p=.007$).

The interaction between think-aloud and direction of translation was not significant, but tests of the simple effects showed that the slowing down effect of thinking aloud was significant only for translating from L2 into L1 (44.67 vs.

58.97, $F(1,7)=15.05$, $p=.006$), and that the slowing down effect of translating into L2 was significant only for translating without think-aloud (49.15 vs. 58.97, $p=.007$).

In sum:

– TA slowed down target text (TT) production; both L2 to L1 and L1 to L2 translation, whether by semi-professionals or by experts, were slower when done with think-aloud than when done without think-aloud.
– Professional translators were faster than final-year translation students ('semi-professionals') by about 20% overall, but the data from the experiment were insufficient to show that this difference was statistically significant.
– L1 to L2 translation was about 16% slower in both groups than L2 to L1 translation. The delaying effect of TA was greater if the language direction was L1 to L2 than if it was L2 to L1, but no significant interaction of TA and language direction was found.

These findings concerning the delaying effect brought about by the TA condition are not surprising. Indeed, Ericsson and Simon explicitly mentioned that there might be such an effect, viz. if verbalisation had to be queued. With the logging methodology employed in the experiments carried out for the present research, we are now in a position to say more exactly (a) that there was indeed a delaying effect and (b) how strong the effect was in different situations. Though this gives us new and more accurate knowledge about a translation research situation, it in no way challenges Ericsson & Simon's more fundamental claim that the think-aloud condition, though it may slow down the primary mental activity, does not change the activity or process structurally.

In order to examine this assumption more closely, two additional features of the target text production process as recorded in *Translog* were investigated, viz. the amount of revision undertaken in the two conditions and the number of text production segments. More revision in one condition would indicate a difference in the quantity of processing engaged in. Different revision practices in one condition might indicate a difference in the kind or quality of processing undertaken. Furthermore, if segmentation in one condition could be shown to be different from the segmentation done in another condition, this would suggest that the processing in the two conditions could not be said to be the same.

Effects on revision

Most text production involves a lot of 'editing' or revision. Some revision is trivial corrections of typos, but generally there are also more substantial changes, either of form or of content. Some revision is done while a translation is being drafted, as 'online' revision, and some is done after the first full draft has been completed as 'end' revision (Krings 2001; Mossop 2001).

Sample examination of some of the log files suggested that several effects might accompany the TA condition. In some of the files the TA condition appeared to affect the typing process negatively, e.g. by provoking more typos. This suggested that the TA condition added cognitive stress to the translator's situation, making it more difficult to type. In others, the TA condition appeared to provoke more semantic changes during revision and to have a positive effect on content revision. This suggested that audible feedback from the subject's own verbalisation had a stimulating effect on the production of semantic solutions and ultimately might have a positive effect on translation quality (Baddeley et al. 1998).

The challenge, from the point of view of the present study, was to find statistical support for any such ideas without resort to qualitative analysis.

The following extract (with most of the temporal information left out) from one of the log files can be used to illustrate some of the difficulties in finding the most relevant way of doing this analysis, and to show the difference between the three revision counts done in the present study.

> **Logged keystrokes:**
> 60,♦0000⊗♦people♦were♦witnessing⊗⊗⊗⊗⊗⊗⊗⊗⊗⊗
> watching♦an♦……between♦the♦two♦largest♦soccer♦clubs♦in♦Uruga
> ⊗uay♦the♦rivals♦Peñarolæ⊗♦and♦Nacional[Ctrl←] [Ctrl←][Ctrl←]
> [Ctrl←]local♦⇨.♦[✳:02.43.39][🖰⊠⊠⊠⊠⊠⊠exciting♦game♦
> ⇨The♦game♦full⊗⊗⊗⊗⊗⊗⊗⊗⊗match♦full♦with♦[🖰][🖰]
> mtac⊗⊗⊗atch♦⇨actionended♦←←←←←♦⇨in♦at♦⊗⊗♦tie♦
> (1-1)♦after♦several♦entertaining ⊗⊗⊗⊗ning♦[✳:01.22.24]
> moments.
>
> **Final target text version:**
> 60, 000 people were watching an exciting match between the two largest soccer clubs in Uruguay- the local rivals Peñarol and Nacional. The match full with action ended in a tie (1–1) after several entertaining moments.

Here the subject first accidentally wrote an extra zero, which was instantly deleted (⊗). The accidental introduction of a space into the figure after the

comma went unnoticed. Then, immediately after writing '60, 000 people were witnessing', the subject deleted 'witnessing' and replaced it with 'watching'. Next, the subject typed 'an' followed by six full stops indicating that s/he was leaving a problem unsolved for the moment. Next, typos in 'Uruguay' and 'Peñarol' were corrected directly after they had been typed. Then followed cursor navigation (Control-Left Arrow) to insert 'local' followed by the keystroke ⇨ (End) to get the cursor back to the end of the current line. After working for more than two and a half minutes on finding a solution to replace the six full stops left earlier, the subject deleted the full stops and inserted 'exciting game'. Later 'game full' was deleted and replaced with 'match full'. Next, 'game' was marked with the mouse and replaced with 'match' (after another typing error had been corrected). Later again, the left arrow key was pressed six times and a space was inserted between 'action' and 'ended'. Finally, after yet another small typo, 'ning' in 'entertaining' was deleted (indicating that another solution was contemplated), but subsequently retyped.

From a research point of view, such typing activity is not all equally interesting. The decisions to change 'witnessing' to 'watching' and 'game' to 'match', the decision to postpone translating an element, and the insertion of 'local' are more important than the fact that the subject's little finger accidentally hit both the 'l' and the 'æ' keys, which are next to each other on the Danish keyboard. However, the fact that the mistake was instantly discovered, as seen by the immediate deletion of the 'æ', is important from the point of view of processing analysis because it indicates how closely this translator was monitoring his/her typing.

Translog, unfortunately, is unable to distinguish between more or less relevant types of editing. The experimental version of *Translog* used in these experiments did a count of all keystrokes and a count of all text production characters (including e.g. spaces, but excluding cursor navigation keystrokes, mouse clicks, and deletion keys). One obvious count, therefore, was to subtract the number of text production keystrokes (Text prod keys) from the total number of keystrokes (Total keys). Since this difference between the total number of keystrokes and the number of text production keystrokes consists almost entirely of text elimination keystrokes, cursor navigation keystrokes, mouse clicks, and the like, it indicates keystrokes that can be unambiguously attributed to text revision activity. The relevant figures for the log-file extract above are: Total keys: 317. Text prod keys: 252. Thus, by subtracting Text prod keys from Total keys, dividing by Total keys and multiplying by 100, one obtains a percentage score (Rev1) of the amount of revision-related keyboard

activity undertaken by a subject. Formula: (Total keys – Text prod keys) / Total keys * 100.

However, while these figures certainly indicate aspects of the subjects' keyboard behaviour in connection with revision, the figures do not really capture the fact that what happens in revision, textually, is not only that normal characters are deleted and that the cursor is navigated, but that new characters are written – no less normal than the characters they replace.

In order to capture this textual aspect of revision, a new calculation was made (Rev2) based on a count of the difference between the number of text production keystrokes (Text prod keys) and the characters (and spaces) in the final target text (TT chars). Revision was here calculated as any character typed in addition to the ones in the final version of the target text. Formula: (Text prod keys – TT chars)/ Text prod keys * 100. Comparison of Rev1 with Rev2 would give an impression of subjects' navigation efficiency during revision. Only detailed 'manual' scrutiny of the log files, however, would make it possible to find out how much text revision was mere correction of typos, and how much was the result of second thoughts about the translation.

The third count that was done (Rev3) was merely an aggregation of Rev1 and Rev2 into a single figure. Formula: (Total keys – TT chars)/ Total keys * 100. A count relating revision keystrokes to the number of source text characters was considered but dismissed as irrelevant.

The figures for revision (Rev1) for the group of semi-professionals are shown in Table 5.

By this count the average amount of revision per 100 keystrokes for each of the four texts was 23.5 (range 22.1–25.0). The figure for revision in the L1→L2 language direction was slightly lower than for L2→L1 translation, contrary to what had been predicted, but only marginally lower. The value for revision under the TA condition (24.0) was higher than for revision without TA (23.0), but again only slightly. The main difference was clearly in the subjects' individual working styles, with subject 1 (S1) doing significantly less, and S4 significantly more, than S2 and S3. The amount of revision-related keystroke activity in S4 was almost twice that of S1.

The figures by the second calculation (Rev2) for the group of semi-professionals are reproduced in Table 6.

Though there was more Rev2 revision in the L1L2 language direction than in the opposite direction and more Rev2 revision with TA than without, the Rev2 figures showed no statistically significant effect on the text, language direction, and think-aloud variables.

Table 5. Keystrokes for the group of semi-professionals with Rev1 percentages and averages by Text, Language direction, TA condition, and Subject.

Subject	Text	TA condition	Total keys	Text prod keys	Rev1 %	AVE by Text	by Ldir	by TA	by Subj
1	2	No TA	704	632	10.2				
2	2	No TA	937	693	26.0				
3	2	No TA	710	550	22.5	Txt1			S1
4	2	No TA	1078	759	29.6	23.0			16.9
1	3	No TA	1062	822	22.6				
2	3	No TA	1278	1053	17.6				
3	3	No TA	1214	916	24.5	Txt2	L1→L2	no TA	S2
4	3	No TA	1556	1078	30.7	22.1	22.6	23.0	23.5
1	1	With TA	560	461	17.7				
2	1	With TA	863	631	26.9				
3	1	With TA	1044	726	30.5	Txt3			S3
4	1	With TA	601	498	17.1	23.9			24.0
1	4	With TA	1311	1089	16.9				
2	4	With TA	2209	1690	23.5				
3	4	With TA	1524	1245	18.3	Txt4	L2→L1	with TA	S4
4	4	With TA	2175	1276	41.3	25.0	24.4	24.0	29.7

Table 6. Text production keystrokes and final target text characters for subjects 1 to 4, with Rev2 percentages and averages by Text, Language direction, TA condition, and Subject.

Subject	Text	TA condition	Text prod keys	TT chars	Rev2 %	AVE by Text	by Ldir	by TA	by Subj
1	2	No TA	632	595	5.9				
2	2	No TA	693	511	26.3				
3	2	No TA	550	465	15.5	Text1			S1
4	2	No TA	759	629	17.1	21.4			8.7
1	3	No TA	822	734	10.7				
2	3	No TA	1053	870	17.4				
3	3	No TA	916	797	13.0	Text2	L1→L2	No TA	S2
4	3	No TA	1078	854	20.8	16.2	18.8	15.8	24.3
1	1	With TA	461	412	10.6				
2	1	With TA	631	488	22.7				
3	1	With TA	726	441	39.3	Text3			S3
4	1	With TA	498	433	13.1	15.5			19.9
1	4	With TA	1089	1006	7.6				
2	4	With TA	1690	1170	30.8				
3	4	With TA	1245	1097	11.9	Text4	L2→L1	With TA	S4
4	4	With TA	1276	1132	11.3	15.4	15.4	18.4	15.6

By Rev1, Texts 1, 2, and 3 seemed to cause slightly less revision than Text 4, but by Rev2 it was Texts 2, 3, and 4 that had the lowest figures. Once again the only major difference was on subject. S1 again came out as the subject doing the least (text) revision. S1 either did not produce very many solutions or preferred not to commit anything to electronic memory until a carefully considered solution had been found. S2 and S3, by contrast, did almost three times as much Rev2 revision as S1, which illustrates a very different text production approach. With their superior typing and editing skills, they preferred to write down ideas immediately as they surfaced rather than hesitate to make sure that they might not have to be revised at a later point. S4's score by Rev2 placed S4 at the lower end (in third place). The high score by Rev1 and lower score by Rev2 is a reflection of the fact that S4 had a lot of cursor navigation keystrokes that did not result in text production. Though S1 did much less revision overall, S1 also did about twice as much Rev1 revision as Rev2 revision, and again, by contrast, S2 and S3 did almost equal amounts of Rev1 and Rev2 revision.

Rev1 and Rev2 both capture relevant aspects of revision, and there is a danger of blurring some of the nuances by aggregating the two into one lump calculation (Rev3) as in Table 7:

Table 7. Aggregated revision figures (Rev3) for the group of semi-professionals.

Subject	Text	Task	TA condition	Total keys	TT chars	Rev3%	AVE by Text	by Ldir	by TA	by Subj	by Task
1	2	1	No TA	704	595	15.5					
2	2	3	No TA	937	511	45.5					
3	2	2	No TA	710	465	34.5	Text1			S1	Task1
4	2	4	No TA	1078	629	41.7	38.9			24.0	41.3
1	3	4	No TA	1062	734	30.9					
2	3	2	No TA	1278	870	31.9					
3	3	3	No TA	1214	797	34.3	Text2	L1→L2	No TA	S2	Task2
4	3	1	No TA	1556	854	45.1	34.3	36.6	34.9	42.0	35.2
1	1	2	With TA	560	412	26.4					
2	1	4	With TA	863	488	43.5					
3	1	1	With TA	1044	441	57.8	Text3			S3	Task3
4	1	3	With TA	601	433	28.0	35.6			38.7	32.8
1	4	3	With TA	1311	1006	23.3					
2	4	1	With TA	2209	1170	47.0					
3	4	4	With TA	1524	1097	28.0	Text4	L2→L1	With TA	S4	Task4
4	4	2	With TA	2175	1132	48.0	36.6	36.0	37.7	40.7	36.0

The main difference by this count was still in the subjects' individual revision behaviour. By this count, S4's revision habits were aligned, somewhat mis-leadingly, with those of S2 and S3, whereas S1 still stood out as significantly

under-revising. Averages by task were included here. They suggested that the task sequence might have had a slight effect on revision behaviour, with subjects tending to revise more at first, then less and less, and finally somewhat more, perhaps an indication that fatigue was beginning to set in. The figure for revision in L1→L2 translation (36.6) was again only marginally higher than for L2→L1 translation (36.0), and the figure for revision in the TA condition (37.7) was only slightly higher than for translation without TA (34.9).

Within subject comparison gave a very mixed picture with no clear tendency. Two of the translations into L2 (English) done with think aloud had more revision than the ones into L2 without think aloud, two had less, and two of the translations into L1 (Danish) done with think aloud had more revision than the ones into L1 without think aloud – and here, again, two had less.

The figures for the group of expert translators were only slightly different. (Task order has been omitted, as there were no effects.) The Rev1 figures were as follows:

Table 8. Keystrokes for the group of expert translators with Rev1 percentages and averages by Text, Language direction, TA condition, and Subject.

Subject	Text	TA condition	Total keys	Text prod keys	Rev1%	AVE by Text	by Ldir	by TA	by Subj
5	1	No TA	638	510	20.1				
6	1	No TA	754	527	30.1				
7	1	No TA	1410	745	47.2				S5
8	1	No TA	519	442	14.8	T1			15.7
9	1	No TA	597	455	23.8	27.2			
5	4	No TA	1474	1277	13.4				
6	4	No TA	1955	1368	30.0				S6
7	4	No TA	3732	1788	52.1				31.9
8	4	No TA	1697	1396	17.7	T2	L1→L2	no TA	
9	4	No TA	2100	1434	31.7	26.8	27.0	28.1	
5	2	With TA	711	600	15.6				S7
6	2	With TA	1074	731	31.9				47.1
7	2	With TA	1422	753	47.0				
8	2	With TA	852	678	20.4	T3			
9	2	With TA	750	609	18.8	25.2			S8
5	3	With TA	1120	967	13.7				17.1
6	3	With TA	1524	981	35.6				
7	3	With TA	1972	1143	42.0				
8	3	With TA	1143	965	15.6	T4	L2→L1	with TA	S9
9	3	With TA	1183	956	19.2	29.0	27.1	26.0	23.4

Here, averages by Text were very uniform (range 25.2 – 29.0), and by Language Direction they were almost identical (27.0 and 27.1). As was the case in the

group of semi-professionals, the TA condition had no significant effect, but contrary to what was the case in the first group, the experts had slightly more revision without TA than when working under the TA condition. Again, the only major difference was by Subject, with S7 revising almost three times as much as S5 and S8.

The Rev2 figures for the group of experts were as follows:

Table 9. Text production keystrokes and final target text characters for subjects 5 to 9, with Rev2 percentages and averages by Text, Language direction, TA condition, and Subject.

Subject	Text	TA condition	Text prod keys	TT chars	Rev2 %	AVE by Text	by Ldir	by TA	by Subj
5	1	No TA	510	399	21.8				
6	1	No TA	527	393	25.4				
7	1	No TA	745	446	40.1				S5
8	1	No TA	442	391	11.5	T1			13.6
9	1	No TA	455	387	14.9	22.8			
5	4	No TA	1277	1134	11.2				
6	4	No TA	1368	1113	18.6				S6
7	4	No TA	1788	1164	34.9				23.7
8	4	No TA	1396	1166	16.5	T2	L1→L2	no TA	
9	4	No TA	1434	1105	22.9	18.0	20.4	17.3	
5	2	With TA	600	532	11.3				S7
6	2	With TA	731	518	29.1				33.0
7	2	With TA	753	541	28.2				
8	2	With TA	678	605	10.8	T3			
9	2	With TA	609	545	10.5	16.7			S8
5	3	With TA	967	870	10.0				12.4
6	3	With TA	981	771	21.4				
7	3	With TA	1143	813	28.9				
8	3	With TA	965	860	10.9	T4	L2→L1	with TA	S9
9	3	With TA	956	839	12.2	20.8	18.8	21.8	15.2

Subject variance was again the strongest effect, with S5 and S8 (and S9) producing the least amount of text not used in the final target text version, whereas S7 appeared to be either a somewhat compulsive reviser or to have integrated revision into her/his working method. Though there was also some variance by Text here, it was too small to be statistically significant. Similarly, the effect on revision by Language Direction was not significant. Slightly more text revision was done when subjects worked towards L2, and expert subjects did considerably more text revision when working with TA than when not thinking aloud while translating. Unfortunately, it was not possible (by the

statistical approach adopted here) to calculate the extent to which this was caused by more typos being corrected with TA, which would suggest that the TA condition added cognitive stress, or by a larger number of semantic options being considered as a result of phonological feedback from subjects' own think aloud.

The nuances brought out in the Rev1 and Rev2 figures disappear in the aggregated Rev3 figures:

Table 10. Aggregated revision figures (Rev3) for the group of expert translators.

Subject	Text	TA condition	Total keys	TT chars	Rev3%	AVE by Text	by Ldir	by TA	by Subj
5	1	No TA	638	399	37.5				
6	1	No TA	754	393	47.9				
7	1	No TA	1410	446	68.4	T1			S5
8	1	No TA	519	391	24.7	42.7			27.0
9	1	No TA	597	387	35.2				
5	4	No TA	1474	1134	23.1				
6	4	No TA	1955	1113	43.1				S6
7	4	No TA	3732	1164	68.8	T2			48.0
8	4	No TA	1697	1166	31.3	39.0	L1→L2	no TA	
9	4	No TA	2100	1105	47.4		40.9	42.7	
5	2	With TA	711	532	25.2				S7
6	2	With TA	1074	518	51.8				64.5
7	2	With TA	1422	541	62.0	T3			
8	2	With TA	852	605	29.0	36.9			
9	2	With TA	750	545	27.3				S8
5	3	With TA	1120	870	22.3				27.4
6	3	With TA	1524	771	49.4				
7	3	With TA	1972	813	58.8	T4			
8	3	With TA	1143	860	24.8	42.7	L2→L1	with TA	S9
9	3	With TA	1183	839	29.1		39.8	38.0	34.7

The aggregate figures by Subject confirm the impression of S7's working style as one that involves revision a good deal above average, but conceals the important distribution of revision across Rev1 and Rev2.

Group comparison

The Rev1 figures (Tables 5 and 8) show that the group of experts navigated the cursor slightly more (or deleted more text) than the group of semi-professionals (27.1 vs. 23.5), regardless of text and condition. This agrees

well with the findings for speed. Experts work faster than semi-professionals. The difference across the two groups by the Rev2 figures was similar to the difference by the Rev1 figures. As a group, experts produced more 'unnecessary' text than semi-professionals under all conditions (average 19.6 vs. 17.1). Though this finding was strongly influenced by the behaviour of one subject in particular (S7), it is interesting to observe that experts engage in substantial revision, seeking to improve solutions beyond mere acceptability.

ANOVA analysis of the effect of think aloud and language direction on revision (Rev2)

The data for revisions were also analysed using a $2 \times 2 \times 2$ analysis of variance.

This analysis showed a non-significant effect of expertise, with slightly more revisions by experts (17.12 vs 19.55, $F(1,7)=.210$, ns). The main effects of think aloud and language direction were not significant either.

Tests of the simple effects for the interaction between expertise and think aloud showed that experts produced more revisions than semi-professionals, especially when not translating while thinking aloud (21.78 vs 15.84 with TA and 17.33 vs 18.41 without, $F(1,7)=2.89$, $p=.13$), but none of the simple effects were significant.

In sum:

–   Contrary to expectation and prediction, no significant effect was found between language direction and revision, whether measured as Rev1 or Rev2 (or Rev3).
–   As had been predicted, no significant overall effect of TA on revision was found. However, the Rev2 figures for the group of experts suggested that TA did have an effect on text revision in this group. All subjects except one (S6) did considerably more text revision without TA than with TA. The fact that this effect did not quite reach statistical significance should probably be attributed to the small sample size.
–   Despite the fact that experts undoubtedly produce text with greater confidence than semi-professionals, they appear to change their text as much or perhaps even more than semi-professionals.

Effects on segmentation

One of the most intriguing psycholinguistic questions concerns the way in which human language processing (comprehension as well as production) proceeds by chunking of the information stream, creating a cognitive rhythm somewhat like the systolic-diastolic rhythm of the heart.

A fundamental assumption behind the analytical method adopted in the present study is that cognitive information processing takes time (cf. Butterworth 1980; Schilperoord 1996; Danks et al. 1997). If L1→L2 translation and translation with TA can be demonstrated to take more time, this is taken to imply that they also require more cognition and make greater demands on processing capacity. However, the fact that some conditions slow down task execution does not necessarily mean that the demand on processing capacity produces different segmentation or 'chunking'. It could be the case that the individual segments remained the same, but that the processing of each segment (under certain conditions) was slower, or pauses between segments were longer. It appeared, however, that the TA condition did in fact compel subjects not merely to process more or less identical segments differently in the TA condition, but to process different segments.

The obvious way of identifying segments in the research design adopted here was to say, in a somewhat *ad hoc* and non-linguistic manner, that a segment was any sequence of keystrokes occurring between two pauses lasting longer than a certain time value. Pause length was an attractive basis for segmentation of *Translog* data because the relevant information was available in the logged data. It was by no means clear, however, what pause length (or lengths) constituted a good criterion. In the data there were no clear threshold values in the distribution of pauses (correlating with e.g. sentences or words), so it was not statistically clear what pause length should be used in the definition of a segment.

No segment definition based on boundary pause length was found that correlated perfectly with text production and/or think aloud data. There was also the possibility that segmentation might differ across subjects, another fact that the definition here adopted was unable to take into consideration.[3]

Schilperoord (1996: 92–93) found the mean duration of pauses coinciding with sentence boundaries[4] to be about 2.6 seconds in his spoken corpus, 8.3 seconds for pauses coinciding with paragraph boundaries. Both of these means resulted from data showing "considerable variances". Goldman-Eisler (1972) also found great variation in the length of between-sentence pauses in spontaneous speech, with many longer than 2.5 seconds. Butterworth

(1980: 165) found that cycles of pauses and utterances typically lasted about 18 to 30 seconds, that cycle boundaries almost invariably coincided with clause boundaries and generally contained five to eight clauses, and that such cycles correlated with 'Ideas' (semantic units) as well as with gesture and gaze in face-to-face communication.

The *ad hoc* segment definition adopted for this part of the study mechanically took any length of keystrokes between two pauses of 5 seconds (or more) to constitute a segment. The average duration of segments found by this criterion was surprisingly uniform for all subjects (between 30 and 35 seconds), though with considerable task variation. The number of segments used for each task differed considerably, however, the main effects being, once again, those of language direction and think aloud.

A further problem was to decide whether to relate the number of segments found to source text units, to keystrokes (total or 'text only'), or to units in the final target text version. Calculating the number of segments by source text units might produce a bias in favour of the comprehension perspective, whereas calculating segments by the other figures might favour the production perspective.

This turned out not to be a problem, however, since the findings were virtually identical. For this reason, only the figures for the number of segments relative to source text units (100 characters, including spaces) are reported below.

Effects of language direction and think aloud

The number of segments (by the five second criterion) in the group of semi-professionals are shown in Table 11.

The average number of segments per 100 characters of source text varied between 3.16 and 9.54. All subjects had the highest number of segments (per 100 source text (ST) characters) while translating text 1, which was the shortest source text. The high number of segments for text 1 could not be attributed to source text shortness, however, since the second highest number of segments (per ST char) occurred in connection with the longest text (text 4).

When translating from L1 to L2, subjects had an average of 7.09 segments per 100 ST characters, 21.7% more than when translating from L2 to L1 (5.55).

When translating with think aloud, subjects had an average of 7.49 segments per ST unit, 31.2% more than when they were not required to think aloud while translating (5.15).

Table 11. Segmentation figures for the group of semi-professionals.

Subject	Text	TA condition	Language direction	No. of segments	No. of segm/100 ST chars	AVE by Text	by Ldir	by TA	by Subj
1	1	With TA	L1→L2	33	8.99				
2	1	With TA	L1→L2	35	9.54				
3	1	With TA	L1→L2	29	7.90	Txt1			S1
4	1	With TA	L1→L2	31	8.45	8.72			6.80
1	4	With TA	L2→L1	68	6.79				
2	4	With TA	L2→L1	75	7.49				
3	4	With TA	L2→L1	38	3.80	Txt4	L1→L2	with TA	S2
4	4	With TA	L2→L1	70	6.99	6.27	7.09	7.49	6.05
1	2	No TA	L1→L2	30	5.75				
2	2	No TA	L1→L2	21	4.02				
3	2	No TA	L1→L2	20	3.83	Txt2			S3
4	2	No TA	L1→L2	43	8.24	5.46			4.87
1	3	No TA	L2→L1	43	5.66				
2	3	No TA	L2→L1	24	3.16				
3	3	No TA	L2→L1	30	3.95	Txt3	L2→L1	no TA	S4
4	3	No TA	L2→L1	50	6.58	4.84	5.55	5.15	7.56
			AVE	40	6.32				

The corresponding figures for the group of expert translators are given in Table 12.

The average number of segments per 100 characters of source text varied between 2.18 and 8.43. All expert translators (except S9), translating the same source texts as the semi-professionals but under opposite TA conditions, had the largest number of segments while translating text 2. Text 3, which had the fewest segments per ST unit in the group of semi-professionals, now had the second highest number.

When translating from L1 to L2, experts had an average of 5.74 segments per 100 ST characters, 16.7% more than when translating from L2 to L1 (4.78).

When translating with think aloud, subjects had an average of 5.90 segments per ST unit, 21.7% more than when they were not required to think aloud while translating (4.62).

Subjects were affected very differently by the TA condition. All had more segments per ST unit when translating while thinking aloud. S6 had almost 50% fewer segments per ST unit when not thinking aloud while translating, whereas S9 only had about 4% fewer segments.

Thus, the seventh and final prediction was contradicted by the data. Think aloud clearly affected segmentation. It forced translators, whether fast or slow, whether expert or not, to chop up target text production into smaller segments.

Table 12. Segmentation figures for the group of expert translators.

Subject	Text	TA condition	Language direction	No. of segments	No. of segm/100 ST chars	AVE by Text	by LDir	by TA	by Subj
5	2	With TA	L1→L2	35	6.70				
6	2	With TA	L1→L2	32	6.13				
7	2	With TA	L1→L2	44	8.43				S5
8	2	With TA	L1→L2	29	5.56	Txt2			5.23
9	2	With TA	L1→L2	30	5.75	6.51			
5	3	With TA	L2→L1	35	4.61				S6
6	3	With TA	L2→L1	35	4.61				4.04
7	3	With TA	L2→L1	48	6.32				
8	3	With TA	L2→L1	28	3.68	Txt3	L1→L2	With TA	S7
9	3	With TA	L2→L1	55	7.24	5.29	5.74	5.90	6.83
5	1	No TA	L1→L2	22	5.99				
6	1	No TA	L1→L2	10	2.72				S8
7	1	No TA	L1→L2	26	7.08				3.83
8	1	No TA	L1→L2	8	2.18	Txt1			
9	1	No TA	L1→L2	25	6.81	4.96			S9
5	4	No TA	L2→L1	36	3.60				6.37
6	4	No TA	L2→L1	27	2.70				
7	4	No TA	L2→L1	55	5.49				
8	4	No TA	L2→L1	39	3.90	Txt4	L2→L1	No TA	
9	4	No TA	L2→L1	57	5.69	4.28	4.78	4.62	
			AVE	33.8	5.26				

Contrary to what had been predicted on the basis of Ericsson & Simon's theory, there was a clear effect of the TA condition on segmentation. It was not the case that the same lengths of segment took more time to process under the TA condition. The segments processed within one cognitive systolic-diastolic movement were plainly shorter and different.

ANOVA analysis of the segmentation data

The data for segmentation were also analysed using a $2 \times 2 \times 2$ analysis of variance.

This analysis showed an insignificant effect of expertise, with a larger number of segmentations for semi-professionals (6.32 vs. 5.26, $F(1,7)= 1.57$, ns).

The other two main effects were significant. There were more segmentations with TA than without TA (6.70 vs. 4.88, $F(1,7)=14.401$, p=.007),

and there were more segmentations from L1→L2 than vice versa (6.41 vs. 5.17, p=.003).

The interaction between TA and direction was not significant (p=.14). However, tests of the simple effects showed that TA was significant at L1→L2 (7.62 vs. 5.21, F(1,7)=12.27, p=.01, that TA was significant at L2→L1 (5.78 vs. 4.56, F(1,7)=6.34, p=.04), and that direction of translation was significant with TA, 7.62 vs. 5.78, F(1,7)=15.74, p=.005).

In sum:

–   As predicted, segmentation varied according to language direction. Subjects segmented target text more often (per 100 source text characters) when translating from L1 to L2 than when translating towards L1.
–   Contrary to what had been predicted, think aloud was found for both groups to increase the number of segments in text production significantly.

Conclusion

The findings in the present study identify and quantify stronger effects of think aloud on translation tasks than predicted by Ericsson & Simon. The knowledge activated during translation must be assumed to be stored verbally in memory. Following Ericsson & Simon, think aloud does not affect the manner and nature of information processing. The present study indicates that the influence of think aloud on processing in translation is quite considerable. Though this forces us to review assumptions about the think-aloud procedure for translation research purposes, it in no way invalidates the think-aloud method. In fact, the most obvious method of trying to answer many of the questions raised by the experiments reported here, and left unanswered in the above quantitative analysis of the logged data, would be to attempt to build hypotheses based both on quantitative computer-logged data and on qualitative think-aloud data.[5]

Notes

1. Subject 9's first language was English, though Danish was stated to be the strongest language. The figures for Subject 9's performance in the tasks suggest that the identification of Danish as this subject's L1 was misleading.

2. The ANOVA analyses and reports were kindly contributed by R. J. Jarvella.

3. There is also the problem of many pauses being Janus-headed indications of both upstream and downstream processing. Lorenzo (1999:26) suggests a practical method for separating the backward-looking monitoring part of a pause from the forward-looking planning part.

4. Schilperoord (1996:82) analyses his spoken data into six hierarchical levels of linguistic expressibility: text, paragraphs, sentences, clauses, phrases, and words.

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The influence of working memory features on some formal aspects of translation performance

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This article deals with the influence of working memory features on translation performance and reports on one of the studies carried out as part of a more comprehensive and recently concluded PhD research designed to investigate the relationship between WM and performance in translation, copying simple clauses in L1, writing in L1, and reading in L2. The research points out that regression models used to verify causal relations did not show a significant influence of WM on translation. However, expert and novices differed as to how their results related to each other. There was evidence that task coordination among the subjects related to typing, whereas processing speed related to measures that tap into higher processes during translation. No evidence was found of the importance of storage capacity. As a conclusion, it is reasonable to suppose that translation experience does not imply acquiring a completely new ability, but rather organizing a better, more efficient, and resource-saving way of approaching the translation task.

Introduction

Translators typically deal with cognitive effortful situations, where they have to manage between many subtasks without loosing sight of the whole. For instance, they may stop the flow of new textual information, hold a specific term or a sentence structure in mind while looking for extra-textual support and, at the same time, not forget to produce a readable text for a specific audience. Considering that expert translators work on an everyday basis, an approach of translation as a cognitive task gives rise to the following question pair: Do expert translators have more cognitive resources than beginners in

order to better cope with effortful situations? And is their mental arrangement of tasks such that they can better use their actual resources?

These questions refer to the cognitive characteristics of translators, a subject matter still not well understood in Translation Studies. Within Applied Linguistics Titone (1971, Chapter 10)[1] was one of the first to indicate the importance of investigating the cognitive characteristics of translators in order to better understand how a translation comes into being. Similarly, Bausch (1977) spelled out a set of the cognitive characteristics important to translation performance. According to the latter, the following "factors of the translator" should be taken into consideration: (a) linguistic competencies, grammatical as well as communicative; (b) specific competencies related to knowledge about extra-linguistic reality; and (c) the translator's competence, beyond those skills used for reading and writing. Since then, the translator's competence has been the dominating concept when it comes to the investigation of the cognitive characteristics of translators.

In my opinion, the above questions indicate a path for further studies on the way professional translators work. A path beyond the more usual question of "What is translation competence?" The rationale behind this opinion is that the questions directly refer to established areas of study within the Cognitive Sciences, in which such questions have long been operationalised and are thus useful for Translation Studies to draw on: individual differences and problem solving, respectively. In this article, I will draw on several studies on individual differences in order to shed light on the translator's cognitive resources. Since the term "cognitive resources" is steadily being replaced by the term "working memory," this study is concerned with how working memory relates to translation performance.

Working memory (henceforth WM) is the ability to keep some information cognitively active while processing that same or another piece of information (Baddeley & Hitch 1994). As such, WM has been conceived of as a limited resource pool, that integrates a processing component to short-term memory. In this sense, the "'Blackboard of the mind' has been a useful metaphor for the limited capacity and processing dynamics of the working memory mechanism." (Goldman-Rakic 1996: 13473). The WM model originally proposed by Baddeley & Hitch is based mainly on neuropsychological investigations whose results, in turn, stemmed from dual-task methodology studies. This has become the dominant view in the field, but it is not the only way of conceiving WM. Alternatively, WM can also be seen a process, rather than as a system, and thus as the interaction of even more basic psychological constructs. Along with storage capacity, there is evidence that processing speed or efficiency (Case,

Kurland, & Goldberg 1982; Salthouse 1996; Salthouse & Babcock 1991) and task coordination (Mayr, Kliegl, & Krampe 1996) also play an important role when storage and processing are simultaneously required. In this perspective, WM is conceived of as a general, formal property of the human information processing system, independently of the content that is to be processed. This view stemmed the results of psychometric studies on individual differences – the field of research that I believe may be useful for Translation Studies. Such studies consist primarily in correlating a series of cognitive capacities with the performance in tasks that require storage and capacity, as a way of unveiling, thus, the role of WM in the activities.

Since the seminal paper by Daneman & Carpenter (1980), there is growing evidence of the importance of WM for the resolution of language tasks. Daneman & Merikle (1996) revised data from 77 published articles and concluded that WM tasks are better predictors for language performance than simple storage tasks. It was demonstrated that WM is correlated with a better performance in syntactic processing (Just & Carpenter 1992), and thematic role assignment (Andrews & Halford 1996), mainly as to what concerns the comprehension of isolated sentences. Drawing on the few investigations at text level, there is evidence that WM is related to the ability to infer the meaning of unknown words (Daneman & Green 1986); to the use of information scattered throughout the text to infer an idea not previously made explicit (Masson & Miller 1983); to establish causal relationships between sentences (Singer & Ritchot 1996); and to the ability to identify some characteristics of textual organization (Tomitch 2000). The same holds for language production: people with better WM capacity are also better language performers – they perform at a faster pace and more accurately, that is, they make less false starts, repetitions, and the like – in speech (Daneman 1991) and written language production (Ransdell & Levy 1996). A perceptually rich environment, e.g. playing background music, may decrease the writing fluency of subjects (Ransdell & Gilroy 2001). What is more, having writers compose in a second language may render the differences between better and poorer performers less evident (Ransdell, Arecco, & Levy 2001).

Considering the literature in Translation Studies, a pool of general resources has also been discussed in relation to simultaneous interpreting (SI) under the label "working memory," or simply referred to as cognitive capacity (Gile 1997). Empirical evidence is nevertheless scarce. Darò & Fabbro (1994) showed in a carefully designed study that SI requires more processing capacity than similar tasks such as listening and shadowing, independently of the direction of interpretation (from the L2 to the L1, or vice versa). In Padilla et

al. (1995), professional interpreters displayed more storage capacity than peer groups of language teachers and interpreting students. These results gave rise to the question of whether training in interpreting decreases the cognitive effort required during the task, as suggested e.g. by Strolz (1994), and tested by Tommola and Hyönä (1996). The authors found, however, that after months of intensive and successful training in SI, there was no difference in mental effort as measured by the very refined technique of pupilometry. Although these three studies cannot be compared directly because of methodological reasons – technically, they operationalised mental effort in different ways and used different measures – they provide interesting insights into the question of how a complex task such as SI is accomplished with limited cognitive resources. Regarding text translation, Séguinot suggests that translators may change their first rendering of a complex sentence, alternating from a less TT-dependent to a more TT-dependent syntax, as a strategy to overcome memory limits (Séguinot 1997:109).

All the above findings indicate that WM is also important to the translation of texts. But, to the best of my knowledge, this question has not yet been addressed empirically. Tackling this question would certainly foster a better understanding of the cognitive demands of the translation task. Also, considering that it is possible to improve WM, studies on this matter could be useful to translator training. Finally, understanding the importance of WM for translation could improve our knowledge of how processing limits constrain complex cognitive tasks. Thus, there is clearly a need to investigate how does WM relate to translation.

This article reports on one of the studies carried out as part of a more comprehensive research (Rothe-Neves 2002) designed to investigate the relationship between WM and performance in translation, copying simple clauses in L1, writing in L1, and reading in L2. I aimed to investigate the extent to which the results were exclusively related to the translation task. In this article, I will concentrate on formal attributes of the translation process. Reference to other tasks will be made only to fuel the discussion. By formal attributes I mean that I did not focus on how the translation decisions were made – hesitations, provisory choices, corrections, etc. – as is normally the case in translation process research. Rather, I focused on measures of pause duration and editing and related them to WM measures. This choice was based simply on the assumption that, as a formal property of the human processing system, WM should be at least related to formal properties of the translation process. To this end, I carried out an exploratory study aimed at assessing what measures and hypotheses can be considered while studying the relationship between the many

ways of measuring processing speed, task coordination and storage capacity, as features of WM, and translation performance.

Method

Participants

Six UFMG undergraduate students, or novice translators, (Group 1; age average: 28.5 years) and six professional translators, or experts (Group 2; age average: 38 years). Professional translators were defined as those who have worked as translators for several years (cf. Laukkanen 1996). Excepting one, novice translators, in turn, were those enrolled in a translation course. The experts were enrolled in an extension course on translation (again, excepting one). All participants had to fill in a questionnaire on demographic questions and background information.

Procedure

WM tests were carried out in one session, and written language tasks in another. The translation was carried out using the *Translog* DOS version software, which they had already used in the immediately preceding copying and writing tasks. Participants were asked to translate the text displayed on their computer screen. No further requests were made. The language pair was Brazilian Portuguese (L1) and English (L2). Before the task, participants were informed that there were no time constraints, that they should try and do their best, and that my main interest was on how long they would take to complete the task. The whole research procedure was then explained. Participants were presented with pre-defined units of the source text, a research paradigm known as "self-paced reading." Each unit consisted of a syntactic segment, "generally a clause with a finite (tensed, conjugated) main verb group along with any non-finite clauses attached to it" (Dillinger 1989:44). After completing the translation of the pre-defined segment, the next unit was displayed by pressing the F1 key. Each unit of the source text disappeared upon display of the following unit. Revision of target text was allowed at any time, but the program prevented backtracking in the source text. This procedure was designed to constrain strategy variation between participants by forcing them into "successive processing" (Krings 1986 cit. in Shreve et al. 1993:24). This procedure was also designed to make participants draw on their WM resources.

The copying task followed the same procedure, but instead of text segments participants were presented with simple clauses (described below).

Materials

WM was assessed with verbal tasks from the BAMT-UFMG, an adaptation of the WM test battery designed by Salthouse & Babcock (1991) to tap into processing speed, coordination, and storage capacity. This battery has been recently validated for Brazilian Portuguese (Wood et al. 2001). The WM tasks were originally developed to fit the concept of WM as made up of simpler constructs. Except in the case of storage capacity, there were more than one task or version of the same task to provide measures of the same construct. This fits the aim of discovering the measure of each construct that best relates to translating. One of the tasks consisted of an oral version of the Reading Span Test, the most widely used WM task (Daneman & Merikle 1996); the oral version is called the Listening Span Test (Daneman & Carpenter 1980). I also used the Digit Symbol, a task that relies strongly on executive functioning (Lezak 1995). Task names and related functions are shown in Table 1.

The source text (303 words) was taken from the first page of *Emma*, by Jane Austen. This text was previously applied by Alves (1997). During the task, participants were allowed to use only the dictionary that is built in the *Translog* software. For the copying task (adapted from Westerman et al. 1998), there were 16 clauses with three words each; words were from three to five letters long.

Table 1. Working memory tasks.

Function	Task
Processing speed	1. Letter comparison (versions with 3, 6 and 9 letters)
	2. Symbol comparison (versions with 3, 6 and 9 symbols)
	3. Sentence comprehension
Storage capacity	4. Word lists
Task coordination	5. Listening span
	6. Digit symbol

Measures

For the process features of translation performance, I applied four measures based on time, and one on writing effort. The rationale behind this choice is as follows: A more efficient performance is achieved when the available

resources are optimally allocated, which in turn means *less* time to carry out a task. Performance time is a *process* feature that has typically been related to efficiency. This is why researchers interested in cognitive processes take task time as an index of task difficulty or of complexity. On many different occasions, others have shown that the greater the difficulty of a task, the longer it will require to be carried out (Gernsbacher 1994). Based on a literature review, I arrived at the following measures of time that may be useful to translation research: fluency rate, keystroke time, production time, and clause time.

Fluency Rate (FR): The proportion of time effectively used to carry out the task. Under controlled situations, pause can be interpreted as planning (for a more detailed discussion, see Schilperoord 1996). In this sense, more complex tasks require more planning and, thus, fluency tends to reduce as complexity increases. Fluency may be measured in various ways (Carroll 1964), and is defined here as the total duration of the task minus the pauses. This measure was used to compare different tasks. In addition, it allows for the investigation of unfinished translations.

Average Keystroke Time (KT): The average working time needed for a single keystroke. It is operationally defined as fluency divided by the total keystrokes. Assuming that pause is related to planning, withdrawing the pause times will allow the keystroke time to provide an estimate of mechanical effort in writing.

Average Production Time (PT): The average fraction of total time necessary to produce characters in the final text. Operationally it is defined as the total task time divided by the number of characters in the final text. In this case, planning is included, but all corrections are excluded from the computation. It is thus an estimate of mental effort, although it does not allow for a qualitative assessment of what was produced.

Average Clause Time (CT): The average period of time necessary to produce a clause in the final text. As stated before, an overall estimate of sentence or segment complexity was obtained according to processing time. But a text is not simply a sum of its sentences. At the text level, one can estimate complexity by the average number of clauses per segment, or *clause density* (Dillinger 1989). Combining complexity at sentence and text level, average clause time estimates the complexity of text due to syntax. It is thus a seemingly important measure, since others have reported that translators work primarily at the sentence level – or at least carry on reading until reaching the sentence boundary and before selecting a translation unit (Alves 1995; Gerloff 1992). What is more, the clause was used before as a measure to investigate reading in translation (Shreve et al. 1993).

The referred measures were used to compare the performance of translators in terms of their time attributes. Another way to estimate performance efficiency is the actual production effort in writing. To estimate performance efficiency I used a measure of *editing rate* (ER): the proportion of editing during the task. It is simply a way to assess the amount of rewriting carried out (by authors or translators) in texts. This measure is defined as the number of total keystrokes minus the number of characters in the final text, again expressed in terms of proportion. Editing rate is a straightforward estimate of effort, but it is insensitive to the quality of the corrections made. It also does not differentiate between characters excluded to improve the text (revision) or typos (correction). As such, editing rate can be taken as a direct measure of proficiency only in the copy task, where the simple clauses to be copied in the L1 do not allow for any kind of revision.

Keystroke time is more closely tied to the typing activity, whereas the other measures capture text production. These measures should not be biased by sentence structure, since a 303-word text should be large enough to afford varied sentence types. The measures should suit the investigation of *how* the translation process was carried out, though they will not allow an assessment of *what* was translated. If the measures show group differences, it will not be possible to assert *where* the differences came from, as in any other on-line measure, unless conditions are manipulated.

Control variables: I asked participants to inform their formal instruction in L2 (in years) and experience living in a foreign country. With the *Translog*, I was able to collect the above performance measurements for a simple copying task. In the translation task, the software also allowed for the assessment of dictionary lookups, indicating how frequently participants accessed the program's built-in dictionary during translation. Data on formal instruction in L2, foreign experience, and dictionary lookups served as estimates of L2 and performance in copying, as well as an estimate of previous experience with personal computers (PC). This measure is important because WM is not the only variable that influences time performance in translation. The procedure and variables presented so far were applied in a pilot-study, partially reported earlier (Rothe-Neves 2001). The procedure proved not overwhelming and the measures seemed to suit the study, excepting the translation task. After the study, I improved the data analysis as discussed below.

Data analysis: Pause is essential for time measures, and it is simply defined as the time span during which work is not registered, or "silence." What comes as a clear definition is in fact a significant problem for written language research, since time is recorded *between* keystrokes. That is, it requires establish-

ing a minimum pause length above which silence should be counted as pause. Below that minimum, silence should be taken mostly as reflecting motor processes. As of this date, there is no standard established for minimum pause length (Kowal & O'Connell 1985). I analysed the pause distribution of each participant in the simple copying task. The cut-off point for extreme outliers was set as the minimum pause length (for details, see Rothe-Neves, in prep.). Since the copying task was designed to collect data related to typing performance, extreme outliers of pauses above the median are very unlikely to represent motor effort. Thus I was able to define the minimum pause length for each participant, which, in turn, was entered in a special program – developed in collaboration with Fernando L. Rodrigues – to automatically generate information from the *Translog* DOS files. The program reads the log file, considers every silence above the set minimum as pause, and then reports total task time, total pause time, total keystrokes, characters in final text, and also generates the measures described earlier. The default cut-off point was 0.5 seconds, but any other choice could have been made. Consequently, the results reported in the next section were based on automatically generated on-line measures of the recorded translation process, except for clause time, which is total task time divided by the number of clauses in the final target text. For that purpose, each target text was analysed according to a linguistic procedure defined for Brazilian Portuguese by Perini (1998).

In sum, this study investigated five formal measures of translation performance and their relation to or possible dependence on three WM components (processing speed, task coordination, and storage capacity), L2, and previous experience with computers. The same five measures applied in the translation task were also applied in a simple copying task, and are thought to reflect previous experience with computers. For the sake of clarity, I will henceforth refer to measures or tasks in capital letters (e.g., Editing Rate), whereas theoretical constructs like L2 or processing speed will be written in lowercase letters.

Results and discussion

Spearman's correlation and simple linear regression analysis were used in a procedure already applied to investigate the influence of WM in language tasks (Baddeley et al. 1985). First, the results of both groups in all measures were correlated with one another within groups. Correlation revealed the few cognitive characteristics closely related to translation performance. Next, the significant variables were entered in a regression analysis to assess how well translation

Table 2. Descriptive statistics and difference between groups.

	Students		Professionals		Difference	
	Median	Variance	Median	Variance	Z[a]	Exact sig.
WM						
Listening span Daneman	4.75	1.37	3.5	1.77	−1.55	0.13
Listening span Salthouse	4.5	1.47	3.5	2.3	−1.4	0.18
Word lists	5	0.7	5	0.17	−1.68	0.24
Sentence comprehension	8.5	5.1	7	1.07	−1	0.39
Comparison of 3 Letters	23	22.67	21.5	26.27	−0.8	0.48
Comparison of 6 Letters	15.5	14.97	13	6	−1.38	0.18
Comparison of 9 Letters	11	14.8	9.5	6.3	−0.81	0.48
Comparison of 3 Symbols	19	28.17	15.5	12.67	−1.05	0.31
Comparison of 6 Symbols	8.5	12.57	8	2.27	−0.16	0.94
Comparison of 9 Symbols	7	4.7	5.5	1.1	−1.14	0.31
Digit symbol	23	16.27	22.5	15.07	−0.24	0.82
Translation						
Keystroke time (in sec.)	0.52	0.03	0.4	0.006	−0.8	0.48
Production time (in sec.)	17.65	40.56	21.22	33.46	−0.64	0.59
Clause time (in sec.)	98.38	1162.24	105.44	733.13	−0.32	0.82
Fluency rate	0.64	0.007	0.62	0.03	0	1
Editing rate	0.52	0.01	0.6	0.009	−1.28	0.24
L2						
Formal instruction in L2 (in years)	3.5	2.2	4	2.57	−2.16	0.04*
Experience in a foreign country (in months)	0	2.64	3.5	441.87	−1.37	0.24
Dictionary lookups	38.5	154.57	16	226.97	−2.49	0.009**
PC						
Keystroke time (in sec.)	0.3	0.006	0.33	0.03	−0.64	0.59
Production time (in sec.)	5.2	2.18	4.94	5.13	0	1
Clause time (in sec.)	8.63	6.28	8.08	13.65	−0.32	0.82
Fluency rate	0.76	0.02	0.76	0.007	0	1
Editing rate	0.13	0.006	0.09	0	−1.12	0.31

(a) Mann-Whitney test of ranks; (*) significant at the 95% level; (**) significant at the 99% level (both 2-tailed).

performance measures can be predicted based on WM characteristics. I will first comment on these results and then relate them to the literature reviewed in the introduction of this article.

In Table 2, the main differences between the two groups were due to L2 level, as indicated by Formal Instruction and Dictionary Lookups. No difference was found in relation to Experience In A Foreign Country, considered an indication of knowledge of language use and pragmatic constraints. Neither

the performance in translation nor the WM measures were significantly different between groups. However, looking at the absolute values and based on the review presented in the introduction of this article, I expected that participants with better capacity would be more efficient. Students scored higher than professionals in all WM measures, which means that they have higher processing speed and more storage and coordination capacity. In general, they also took less time to do the translation task, as indicated by the Production and Clause Times. Conversely, students were slower than professionals in the Keystroke Time measure, which does not includes pauses and thus reflects mechanical effort in typing during translation. If professionals typed faster and took more time, the difference should be attributed to more planning, a fact corroborated by the results of Fluency Rate: students spent 63% of their time typing, whereas professionals, 60%. In turn, the editing rates show that 50% of all typing made by the students was unused; among the professionals, this rate was even higher at 61%. In other words, professionals worked more on their texts. Although we do not refer here to the content of the translation process, it seems to me that there are two clearly distinct processes: professionals took more time to think about what to type and they worked more in their translations than students. That it obviously took more time for professionals to solve their tasks does not challenge the view that time is an index of effort, as can be seen by the combined interpretation of the two measures. But it does challenge the idea that the translation process should require less effort for professionals, a point I will return to later on.

As mentioned earlier, each measure was checked for a correlation with other measures, but not much turned out to be significant, as seen in Table 3.

Table 3. Correlation (rho) between WM, PC, L2 and Translation performance.

		Keystroke Time	Clause Time	Fluency Rate	Editing Rate
Novices	Comparison of 6 Letters	−0.75 (0.08)			
	Editing Rate – Copy	−0.83 (0.04*)			
Prof.	Sentence Comprehension	0.83 (0.04*)			
	Comparison of 6 Letters			0.87 (0.02*)	
	Comparison of 3 Symbols		−0.89 (0.02*)		
	Comparison of 6 Symbols	0.91 (0.01*)			
	Comparison of 9 Symbols				−0.88 (0.02*)
	Digit symbol	0.89 (0.02*)			
	Fluency Rate – Copy	0.83 (0.04*)			
	Editing Rate – Copy	0.77 (0.07)			

(*) significant at the 95% level (2-tailed).

The results between the 0.05 and 0.1 levels are also reported because they may indicate a tendency in such a small sample. Due to sample size, the correlation coefficients are unusually high compared to their significances. The first result to be considered is that the L2 measures were totally unrelated to translation performance. This could be due to the fact that L2 level is important in early stages of second language acquisition, and that Group 1 already had a good enough level of L2 for the task of translation. The idea that the L2 measures applied were not sufficient to capture the L2 level can be dismissed, since these measures turned out to be important for total time in the reading task. The second interesting fact is that except for the storage task (Word Lists), which is completely absent, WM measures did not correlate significantly with any performance measure in Group 1, but with several of these same measures in Group 2.

In Group 1, the only significant correlation was between Editing Rate in the copy task and Keystroke Time. This was expected since Editing Rate in the copy task refers to typing errors and Keystroke Time, to mechanical effort in typing. The negative correlation means that by decreasing time per keystroke (in other words, by increasing typing speed) errors tend to increase. Lack of expertise in typing speed is directly related to errors. But this is not a very significant finding and it can be dismissed when cognitive planning is taken into account (Clause Time). Note that in Group 2, Editing Rate in the copy task also positively correlated to keystroke time.

Measures of WM and PC significantly correlated to the performance of Group 2 – except for Editing Rate in the copy task, which showed only a tendency to correlate to those measures. The interesting fact here is that, except for Production Rate, all performance measures significantly correlated to at least one processing speed task, but no speed task correlated to more than one performance measure. This could be taken as an indication that, in fact, the performance measures used represent different aspects of the translation process, requiring thus abilities that are tapped by different WM tasks. Keystroke Time correlated to various speed tasks, but also with tasks of PC (Fluency Rate and Editing Rate in the copy task) and coordination (Digit Symbol). Clause Time and Editing Rate, in contrast to Keystroke Time, are measures that represent more important aspects of the process, and they all significantly correlated to processing speed tasks.

Next, regression analysis was carried out to estimate process measures from the significant correlations established above. Regression analysis is an important step in to be taken because the variables are introduced in a relational model, whose result allows for inferences about causality. There are

10 significant correlations and tendencies in Table 3. They were all entered in regression models, one by one. Also, as keystroke time correlated to two measures of Group 1, they were entered in a third model (model 3, Table 4). This was carried out tentatively, because a regression analysis should not be carried out with less than five subjects per variable. However, this is the case of the models with one variable. Therefore, model 3 in Table 4 cannot be used to support any conclusions.

Table 4 summarizes all models ("Enter" method) with predictors, dependent variables, and the significance of the model. An analysis of variance estimated the proportion of the total variance of the data that accounted for by each model. The result is reported under R^2, which shows that none of the two models in Group 1 will suffice, because they can only explain 21% and 32% of Keystroke Time in Translation, respectively. Nevertheless, the explanatory power shrinks even more when R^2 is corrected to the number of participants in that small sample (Adj. R^2). In conclusion, the results show that among novices there was no evidence that WM features caused notable changes to translation performance. The most important models for Group 2 were models 4 and 6, both almost reaching significance levels. Models 7 and 9 to 11 explained over 50% of variance in the dependent variables. All significance values are

Table 4. Summary of Regression Models.

Model	Predictors [*]	Dependent Variable	R	R^2	Adj. R^2	Std. Error	F	Sig.
Novices								
1	C6L	KT	0.46	0.21	0.02	0.17	1.08	0.36
2	ER-Copy	KT	0.57	0.32	0.15	0.16	1.89	0.24
3	C6L, ER-Copy	KT	0.75	0.57	0.28	0.14	1.96	0.28
Prof.								
4	SC	KT	0.8	0.63	0.54	0.05	6.92	0.06
5	C6S	KT	0.59	0.35	0.18	0.07	2.12	0.22
6	Digit Symbol	KT	0.81	0.65	0.57	0.05	7.53	0.05
7	FR-Copy	KT	0.72	0.52	0.4	0.06	4.30	0.11
8	ER-Copy	KT	0.69	0.48	0.34	0.06	3.58	0.13
9	C3S	CT	0.76	0.57	0.46	19.78	5.37	0.08
10	C6L	FR	0.71	0.50	0.38	0.13	4.03	0.11
11	C9S	ER	0.72	0.51	0.39	0.07	4.24	0.11

KT: Keystroke time. CT: Clause time. FR: Fluency rate. ER: Editing rate. C6L: Comparison of 6 letters. SC: Sentence comprehension. C3S: Comparison of 3 symbols. C6S: Comparison of 6 symbols. C9S: Comparison of 9 symbols. [*] Constant included.

higher for Group 2 than for Group 1, so one can conclude that WM features are more important predictors of translation for expert than for novice translators. However, as for Group 1, no model for Group 2 has reached significance. F statistic results from analysis of variance of regression versus residuals. The significance of the above mentioned models, despite the limitations of this study, could be drawn also from Table 5. Column B shows the coefficients for the constant and the predictor, respectively. Beta coefficients can be understood as the importance of the predictor.

The correlation and regression data reported here indicate that WM is more important for professional translators than for novice ones. This raises the question of whether the same pattern perceived among professionals is present among students, though in less evident fashion. To answer this

Table 5. Regression Models Coefficients.

Model*		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.83	0.3		2.73	0.05
	Comparison of 6 letters	0.02	0.02	−0.46	−1.04	0.36
2	(Constant)	0.71	0.15		4.77	0.01
	Editing rate – Copy	−1.25	0.91	−0.57	−1.38	0.24
3	(Constant)	1.05	0.29		3.55	0.38
	Editing rate – Copy	−1.32	0.84	−0.6	−1.56	0.22
	Comparison of 6 letters	−0.02	0.02	−0.5	−1.30	0.28
4	(Constant)	−0.05	0.18		−0.28	0.79
	Sentence comprehension	0.06	0.02	0.8	2.63	0.06
5	(Constant)	0.16	0.18		0.89	0.42
	Comparison of 6 symbols	0.03	0.02	0.59	1.46	0.22
6	(Constant)	0.05	0.13		0.36	0.73
	Digit Symbol	0.02	0.01	0.81	2.74	0.05
7	(Constant)	−0.07	0.23		−0.31	0.77
	Fluency rate – Copy	0.65	0.31	0.72	2.07	0.11
8	(Constant)	0.12	0.19		0.73	0.50
	Editing rate – Copy	3.44	1.82	0.69	1.89	0.13
9	(Constant)	185.75	39.77		4.67	0.01
	Comparison of 3 symbols	−5.76	2.49	−0.76	−2.32	0.08
10	(Constant)	−0.03	0.32		−0.09	0.93
	Comparison of 6 letters	0.05	0.02	0.71	2.01	0.11
11	(Constant)	0.97	0.17		5.52	0.01
	Comparison of 9 symbols	−0.06	0.03	−0.72	−2.06	0.11

* Model number refers to Table 4 above.
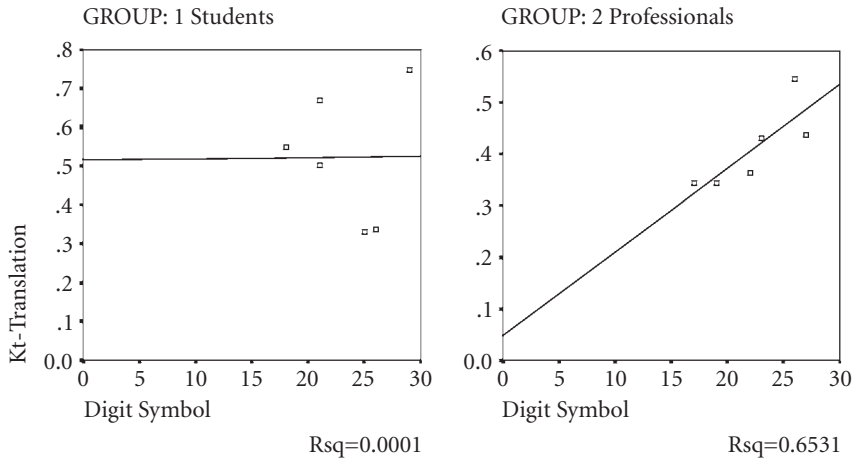
Figure 1. Digit symbol (predictor) and keystroke time in translation.[2]

question, the dispersion graphs with the WM measures as predictors and the performance measures as dependent variables were examined, as shown in the examples in Figures 1–3. In the graphs, called scatterplots, each point is a participant, located according to scores in WM tasks and translation performance.

Figure 1 shows the difference between groups in the prediction of Keystroke Time based in Digit Symbol, from almost no relation in Group 1 to a very clear line indicating that more coordination capacity (Digit Symbol) related to more time in producing a keystroke in Group 2. In order to comprehend this difference, it is important to recall that there was no significant difference between the groups in the raw data (Table 2), neither in relation to Digit Symbol nor to Keystroke Time. The graph shows a change in the relationship between the measures, from no relationship to a positive relationship. The same pattern holds for the pair Comparison with Six Letters vs. Fluency Rate (not shown here). Two other patterns of relationship appeared in the data, comparing students and professionals.

Figure 2 exemplarily shows a pattern of increasing relationship between Comparison of 3 Symbols and Clause Time, in which there is a positive relationship in both groups, but only in Group 2 showed a significant relationship. Conversely, Figure 3 shows an opposite pattern: in Group 1 there was a positive relationship between Comparison of 9 Symbols and Editing Rate, though not significant, which changed to a significant negative relationship in Group 2. The same was observed in two other pairs not shown here: Comparison of 6

GROUP: 1 Students   GROUP: 2 Professionals

Rsq=0.2756   Rsq=0.5730
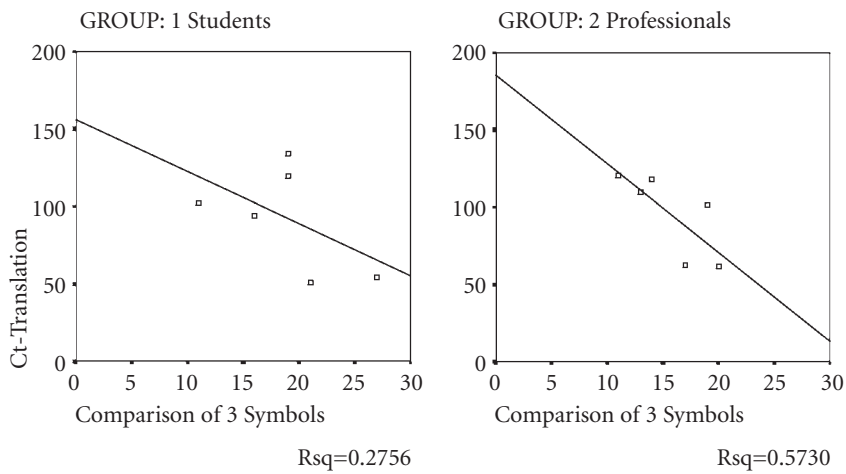
Figure 2. Comparison of 3 symbols (predictor) and clause time in translation.

GROUP: 1 Students   GROUP: 2 Professionals

Rsq=0.2456   Rsq=0.5145
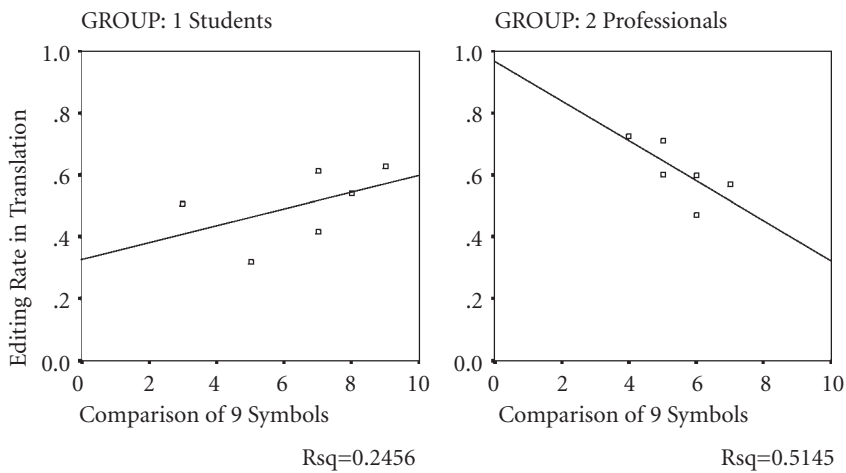
Figure 3. Comparison of 9 symbols (predictor) and editing rate in translation.

Symbols vs. Keystroke Time and Sentence Comprehension vs. Keystroke Time (however in the opposite direction, from a negative relationship in Group 1 to a positive one in Group 2.

What do these patterns mean? There is almost nothing than can be generalized from each group plot, since every possible pattern of relation was observed. But examining the plots of Group 2 in all tasks, an interesting fact arises. In order to directly compare all measures Z scores were used so that all

measures become a difference to their own mean, and thus each group measure has its mean = 0.

In some tasks (Figure 4), WM related to performance in a clear and significantly positive way: increasing WM means equated with increasing performance in translation. In this case, keystroke time and FR accounted for performance, two measures strongly based on typing behaviour. The students' group, however, showed no particular pattern, with data more scattered through the graph. On the other hand, a couple of tasks showed a different pattern, with
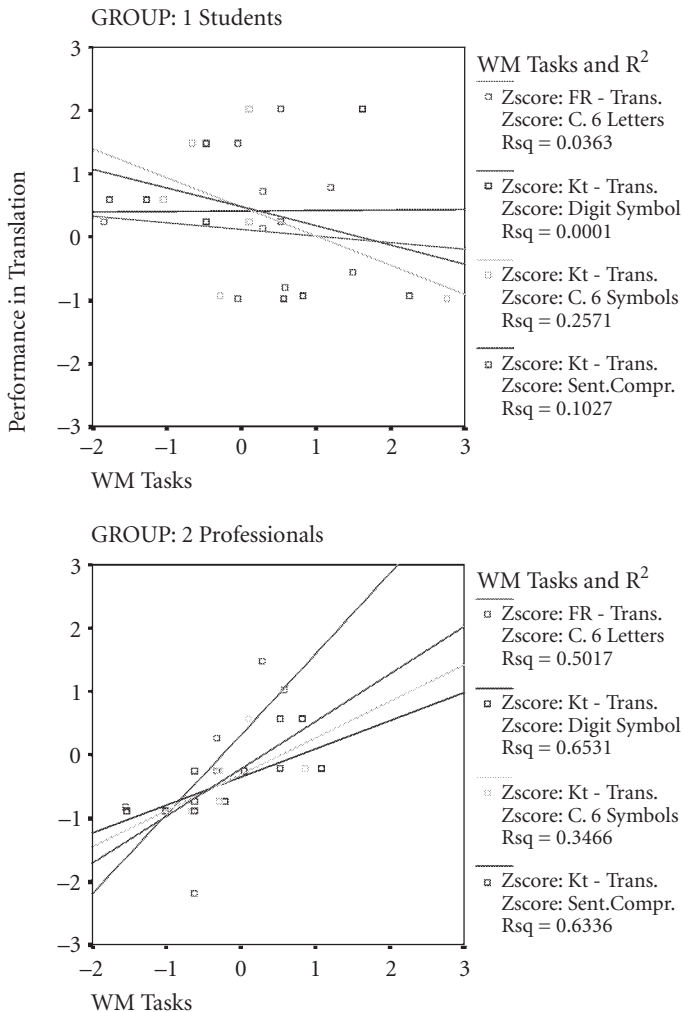
Figure 4. Z scores of WM tasks (predictors) and performance based on typing.

a clear negative relationship: increasing WM equalled decreasing performance (Figure 5).

Again, Group 1 showed scattered data. Performance, in that case, refers to measures that are not exclusively based on typing. Clause time is the average time to produce a clause in the final text, and accounts for the total time the translator spent thinking. Editing Rate refers to every keystroke typed and deleted before the final version was completed. Both measures are more related to translation than just in terms of typing, and both behaved in the
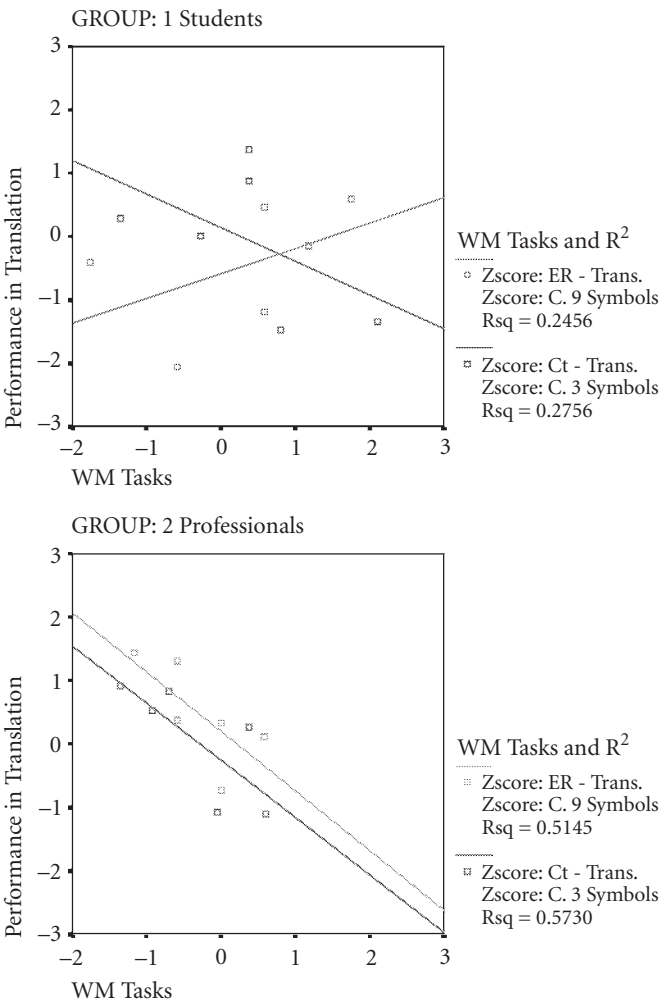
Figure 5. Z scores of WM tasks (predictors) and performance not based on typing.

same, very intuitive way compared to WM: with more processing resources, the time to produce a clause decreases as does the amount of unused text. As said earlier, these two measures were chosen because they may be related to process efficiency. Deleting decreases process efficiency – the more we delete, the less efficient the process. Also, the more time to produce a clause, the less efficient the process. So, the Group 2 graph in Figure 5 shows, unmistakably, that WM related to process efficiency in translation performance, because the greater the WM capacity, the less the participant deleted and the less time spent on a single clause.

Figure 4 is less intuitive. Fluency Rate is the proportion of the total task time actually spent typing. The plot for the group of professionals shows that the greater the WM capacity, the greater the Fluency Rate, that is, the less the participant had to think without actually acting on the text. This was expected from the literature on speech and written language production revised before. Keystroke Time, however, should decrease, but in Group 2 it increased, which means that the more cognitive resources, the longer a group 2 participant took to make a single keystroke. In order to make sense of this, I recall an above comment on the median raw data (Table 2 above). By comparing the group medians, we have seen that professionals took more time to think about what to type, and that they worked more on their translations than students. Now it is time to readdress the hypothesis that the translation process should require less effort for professionals. This hypothesis was drawn from research on WM based on simple tasks (see discussion in Darò & Fabbro 1994). Nevertheless, translation is a complex task and, as indicated by previous research on writing, experts tend to identify more problems and thus take longer not at text surface level, but at organizing solutions (Hayes & Flower 1996). This could easily decrease average keystroke time. Also, this could explain why effort did not decrease after training in SI (Tommola & Hyönä 1996): it seems that effort is simply redirected at previously undetected problems.

Conclusion

The results presented and discussed in this article could be summarized as follows. Regression models used to verify causal relations did not show a significant influence of WM on translation. However, expert and novices differed as to how their results related to each other, as seen from each correlation matrix. Plotting the results of performance as a function of WM features, the data from students ended up scattered throughout the graph, both

in Figure 4 and 5, whereas they showed an organized pattern for professionals. This pattern is very similar to that found in the literature. Expert translators with more processing speed and coordination capacity were more fluent, needed less time to produce their clauses and made less revisions until arriving at the final draft. In other words, the more WM capacity, the more efficient the performance. Because of sample size, the findings presented here must be interpreted carefully. They should not be taken as solid facts, but rather as indications for further research. Next, I will explore the two main points that arise from the study: the dissociation between novice and experts, and the role of WM components in different aspects of the translation process.

Regarding the components of WM, there was evidence that task coordination related to typing, whereas processing speed related to measures that tap into higher processes during translation. I found no evidence of the importance of storage capacity. These results could only be achieved because a factor model of WM was applied. In system models (e.g., Baddeley & Hitch 1994), this result would probably be confounded. Considering that translation is a complex process, a question remains as to whether processing speed relates, as a general feature, to every step of the process (source text segmentation, information recall etc.). This question requires a closer look at the process files of each translator, a task I am currently involved in. A second research strategy that could be useful for future research to disentangle different parts of the translation process is the part-task approach advocated by de Groot (1997). Instead of trying to figure out the whole process at once, the part-task approach involves getting the participants do different easier tasks that compose the translation process, such as copy and revision. If different characteristics are related to different process measures, as I have presented here, the part-task approach may allow for a closer investigation of which cognitive characteristics are more important for different aspects of translating.

For Translation Studies, however, perhaps the most interesting results presented here are those concerning the difference between novices and experts. They are even more interesting as "expert" was defined simply as translators who have worked as such for several years. Though easy to operationalise, this definition is not considerably revealing in terms of what makes a professional translator. Several issues for future research could be drawn from the results presented here. First, there is the fact that L2 was significantly different between the groups, but not related to any performance measure. Before it is taken as an indication that translation has indeed less to do with L2, I must recall that L2 in this study means years of formal instruction in a second or foreign language, experience in a foreign country, and the frequency of dictionary lookups. A

placement test could provide further evidences as to how L2 correlates with, e.g., fluency in translation. The fact that no regression model was significant means that there are other cognitive characteristics involved. As task coordination has provenly shown some value, executive functioning and metacognitive skills could also be investigated.

The fact that novices and experts had different correlation matrixes despite the similarities in the table of results is an indication that they arrived at the same results by means of different resources. In other words, it is reasonable to suppose that translation experience does not imply acquiring a completely new ability, but rather organizing a better, more efficient, and resource-saving way of approaching the translation task. Although this study should be submitted to retesting with larger samples and in different conditions, it indicates that approaching translation as a problem-solving activity is indeed adequate and promising.

Notes

1. The reference of the Italian original is given here according to the Brazilian translation of 1983.

2. Rsq stands for "R square", a measure of how good the line fits the points, with values between 0 ad 1.

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PART III

Pedagogical applications

Patterns of dictionary use
in non-domain-specific translation

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The article describes the use vs. non-use of dictionaries by semi-professionals when translating a non-domain-specific text from L1 into L2 while thinking aloud. It was hypothesised that if post-graduate students had first been required to translate the passage to their satisfaction without dictionaries, they would not feel a great need to use them if they were given access to them at a later stage; and that, for students at this level, the use of dictionaries would have no significant effect on the quality of the product. The second hypothesis was confirmed, but no support could be found for the first. It is concluded that students overuse dictionaries, focussing too narrowly on lexical units at the expense of other factors such as context. In addition, the think-aloud protocols suggest that translation training focussing more specifically on the process provides a new pedagogical approach which makes it possible to give advice to students on their individual strengths and weaknesses.

Introduction[1]

This article discusses the results of three experiments carried out at the Copenhagen Business School (CBS) in 1997 which had the aim of comparing translation into the foreign language carried out with or without access to dictionaries.[2] Inspired by Krings (1986:55), we had as our objectives (1) the investigation of how, and to what extent, students use dictionaries when translating non-domain-specific texts; (2) to discover whether the use of dictionaries influenced the quality of the translation product. The subjects were ten of our most competent post-graduate students of English (all with Danish as L1), who were asked to translate a newspaper passage (consisting of 126 words) from Danish into English.

Methodological considerations

This study employs the introspective methods developed by Ericsson and Simon (1980, 1984) and adapted to translation studies by Krings (1986) in his pioneering work *Was in den Köpfen von Übersetzern vorgeht*. Over the years they have become a major instrument in process-oriented translation studies (Krings 2001: Ch. 3; Königs 1996; Tirkkonen-Condit 2002). In particular, much research has employed concurrent verbalisation, or think-aloud protocols (TAPs); see, for instance, Kiraly (1995), Kussmaul (1995), Lörscher (1991), Tirkkonen-Condit (1991) and Tirkkonen-Condit & Jääskeläinen (2000). Criticism has been levelled against these introspective methods, in particular that subject behaviour is likely to be influenced by the 'artificiality' of an experimental situation; consequently, it is necessary for researchers to aim at diminishing such effects. To quote one example, it is shown by Jakobsen (this volume) that the think-aloud procedure generally slows down translation speed – this was in fact the reason that our subjects were given unlimited time for the task. More recently, this qualitative approach has been supplemented by more objective quantitative methods, notably the key and time log PC program *Translog* (Jakobsen 1998, 1999). The present study combines both methods even though the conclusions in this paper are based mainly on an analysis of the think-aloud protocols.

Another measure taken to minimise influence from the experimental set-up was to let subjects familiarise themselves with the think-aloud situation in a short warm-up session. In addition, we took steps to counteract the possibility that subjects treated their verbalisation more as messages to the researcher than as a stream of spontaneous thinking. This was achieved by the experimenters being in a different room, separated from the participant by a glass panel through which they could see the subjects without being seen. We could also hear them via an audio link, but needless to say we never interfered with the think-aloud process by speaking to them or asking them to 'say something' if there were pauses in their thinking aloud. Although most of them stated afterwards that they had simply forgotten all about us, we obviously cannot know whether this was in fact the case. As suggested in Hypothesis 3 below, it is very likely that the set-up of the experiment influenced (i.e. increased) the number of dictionary consultations, but the study gives no indication that it changed look-up behaviour qualitatively. For a critical analysis of the advantages and drawbacks of introspective methods, see Ericsson and Simon (1993).

It is, of course, impossible to set up a scenario in which the same subjects translate an unknown text both with and without access to dictionaries (it would clearly cease to be unknown after the first session). Researchers have tried in various ways to overcome the problem of having the same subjects use the same text under different conditions, for instance, by having a relatively long time-span between the two experiments (Orozco 2000). However, we decided against this procedure for two reasons. Firstly, even if such a long time-span had been inserted between the two sessions, the question might still arise of whether the subjects could possibly have remembered parts of the text and ways of dealing with its intricacies. Secondly, it may be assumed that students would improve their language skills between the two sessions, thus introducing non-controllable variables. Other researchers have tried to solve the problem by using texts which although different were judged to be of about the same degree of difficulty (Jensen 2000); however, our pilot studies had made us doubt whether it is in fact possible to design such texts. Therefore we decided to adopt an alternative approach: namely, confronting two different, but comparable, groups with the same passage. In addition, we were able to devise a procedure by which one group did in fact translate the same text firstly *without* and, subsequently, *with* access to dictionaries.

The source text – which is found in the Appendix below, together with a possible English translation – has been taken from the news section of the Danish quality newspaper *Politiken*. The 126 word passage was topical at the time of the experiment in 1997, when Denmark had unsuccessfully tried to persuade the UN Commission for Human Rights to pass a resolution criticising human rights in China. It describes the Danish Foreign Minister's comments on Denmark's reaction to Chinese anger at this attempt. The text was chosen on the basis of such criteria as topicality and a certain degree of complexity. Furthermore, we wanted several types of problem areas to be represented, e.g. metaphors, collocations (some of which unusual) together with potentially ambiguous expressions – the meaning of which had to be derived from the context (cf. Krings 1986:52–53). Our choice of a non-domain-specific text covering a topic with which the students would be familiar was therefore deliberate. Since our focus – unknown to our subjects – was to examine the role of dictionary use in general translation, we would have found a domain-specific text less suitable. There would be a risk that participants might expect the experiment to be a test of their skills in and strategies for finding precise domain-specific terminology – and thus divert their focus away from other aspects of translation (such as context). As explained in Hypothesis 3, we did in fact anticipate only a modest need for dictionary use with a text of the type

chosen for the present experiment. This should not be taken to mean that an investigation of search strategies for domain-specific lexical knowledge is without interest. However, this would have called for a completely different experimental set-up, possibly on the lines of Krings (2001).

Research design

Ten individuals were enrolled for the study: five of these participated in Experiments 1 and 3, while five different subjects were engaged for Experiment 2.

Experiment 1

The five students undertaking Experiment 1 were asked to think aloud while translating. Their utterances were recorded on audio cassette while they produced their translation using *Translog* (Jakobsen 1999; Jakobsen & Schou 1999). Transcripts were later made of all audio recordings. The students translated the passage without being given the chance to consult dictionaries, but were given no time constraints; they were instructed to continue with the process until they felt they could no longer improve on the result.

Experiment 2

In Experiment 2, five participants, all of similar background and experience to those in Experiment 1, translated the same text under identical conditions except that this second group had access to dictionaries from the outset. The dictionaries chosen were those which are most frequently used by CBS students during their translation training, namely Vinterberg and Bodelsen (1990), henceforth VB – the most comprehensive bilingual Danish-English dictionary – and the monolingual *Longman Dictionary of English Language and Culture* (1992), henceforth LDELC.

Experiment 3

After subjects had completed Experiment 1 and believed that the session was over, they were asked to take a short refreshment break and return. We now requested them to look at their translation again, telling them that it was believed that solutions to problems would sometimes suggest themselves when one did not focus on the text. This phenomenon has been called 'parallel

activity technique' (Kussmaul 1995:43). The same dictionaries that had been given to the subjects in Experiment 2 were now made available to these participants, but they were not instructed specifically to make use of them. As described above, the 10 subjects produced 15 different target texts in all, i.e. five products from each of the three experiments. Three translation teachers evaluated the texts; these evaluators were not told – and did not realise – that five of the participants had produced two separate translations, i.e. one as the end result of Experiment 1 and one as that of Experiment 3.

The translation examination at CBS which tests non-domain-specific L1 – L2 translation takes place about six months before the students complete their postgraduate studies. All 10 students in the experiments had previously sat this exam – which does not permit access to reference works. The evaluators, who were unaware that certain of the translations had been produced with the help of such books and others without, were told to use the same criteria as for the above mentioned examination, i.e. to treat them as products of functional translation. This implies that a grade was awarded for the degree to which the text reads as natural English newspaper material while still being a faithful rendering of the Danish source text, and catering for the cultural needs of the recipient.

Hypotheses and results

We postulated the following hypotheses.

Hypothesis 1

Allowing access to dictionaries will increase the amount of time spent on a translation assignment. Thus, Experiment 2 subjects were expected to spend more time on the assignment than those in Experiment 1.

This hypothesis was shown to be valid: the average time spent per student on translation in Experiment 1 was 54 m. as compared with 80 m. for Experiment 2.

Hypothesis 2

Competent post-graduate students who translate a non-domain-specific newspaper text *with* access to dictionaries from the outset will feel a great need to consult such works simply because their availability is in itself an invita-

tion to use them. This also holds true in cases where the translators are virtually certain that they have already found a satisfactory solution to a particular translation problem.

Hypothesis 2 was also confirmed. The subjects in Experiment 2 used dictionaries in connection with more than half of the units verbalised (64 out of 120 units, i.e. 53.3%). Interestingly, Krings (1986: 397), who conducted similar L1-L2 translation experiments (German – French), found that his four subjects used dictionaries even more extensively (i.e. for two-thirds of the units).

Hypothesis 3

Competent post-graduate students who have translated a non-domain-specific newspaper text *without* access to dictionaries will not feel a great need to consult dictionaries if these are subsequently made available. We assumed that the long period during which they had been left to their own resources would have forced students of this high standard to solve most problems before they were given access to dictionaries. As stated above, our subjects were used to working without dictionaries: at CBS, the terminal examination of the L1 – L2 general language translation course, which all of them had passed with high grades prior to our study, is conducted without access to reference works.

On examining the number of dictionary consultations, we found, to our great surprise, that there were nevertheless consultations for 51 out of 121 verbalised units, i.e. 42.2 %. Thus our third hypothesis was not confirmed: these results clearly show that the group still felt a great need to consult dictionaries.

If we compare the two groups, we can see that Experiment 3 subjects – in line with our prediction – used dictionaries less frequently than those in Experiment 2, but the difference was far smaller than we ourselves predicted. Even if we take into account that the way in which Experiment 3 was set up may have increased dictionary use, this finding must be regarded as surprising.

Hypothesis 4

Students with a high level of L2 competence, such as those taking part in these experiments, are able to translate a non-domain-specific newspaper text using their own resources. Therefore allowing access to reference works – irrespective of the point at which they are made available – will have no significant effect on the quality of the translation.

This hypothesis was confirmed – and in far greater measure than anticipated. In fact, out of the total of 115 units tackled with the aid of dictionaries (64 in Experiment 2 and 51 in Experiment 3; see hypotheses 2 and 3 above), there were only 21 cases in which dictionary use could be said to have significantly improved the quality of the product.[3] See discussion below.

Discussion

The results and behavioural patterns for the two groups participating in the experiments were so similar that we decided to conflate them (see findings quoted for Hypothesis 4 above). Following in the footsteps of Krings (1986: 113), we consider translation problems – and hence define 'translation unit' – from the perspective of the participating subjects. A translation unit is any word or phrase in the text, or any aspect of a such a word or phrase, which is verbalised by any single participant and for which he or she expresses any degree of doubt about its proper translation.[4] For example, we found that a single word may in fact represent as many as *four* units. A case in point is the translation of the Danish word *menneskerettighedskommissionen*, where students might experience problems with one or more of the following aspects: (1) spelling (initial capitals or not); (2) choice of word ('commission' versus 'committee'); (3) grammatical form of 'right(s)' (singular or plural); and (4) the structure of the phrase: ('Human Rights Commission' vs. 'Commission on/of/for Human Rights'). Our definition of the term 'unit' is in agreement with Alves, Magalhães & Pagano (2001), who define a translation unit as a dynamic entity, i.e. 'a segment of the source text independent of specific size or form to which, at a given moment, the translator's focus of attention is directed. It is a segment in constant transformation that changes according to the translator's cognitive and processing needs' (translated from Portuguese).

Not only the number of units verbalised but also the manner in which these were dealt with by the two groups were almost identical. There were 241 verbalised units in all: 121 in Group 1 (i.e. Experiments 1 + 3) and 120 in Group 2.[5] We focused on the 115 in which consultations took place (51 in Group 1 and 64 in Group 2).[6] Our figure of 115 consultations refers to the complete treatment of a unit by any given student, so that what we have termed a 'consultation' may cover several dictionary look-ups. For instance, Dina is in doubt as to whether *menneskerettighedskommissionen* should be translated as either 'Human Rights Committee' or, alternatively, 'Human Rights Commission'. On looking up *kommission* in the Danish-English

dictionary (VB) she fails to find sufficient information to make a choice. She therefore first looks up *commission* and then *committee* in the monolingual dictionary (LDELC), and on the basis of the entry opts for *commission.* Thus, this whole procedure counts as one consultation consisting of three look-ups. The 115 dictionary consultations undertaken by our subjects in reality involved no fewer than 179 look-ups. Of these, 106 were in the bilingual VB dictionary, and 73 in the monolingual LDELC dictionary (59 % and 41% respectively). It may be noted that this distribution is markedly different from Krings (1986:397), whose results came out as: 86% consultations in bilingual dictionaries vs. 14% in monolingual dictionaries.

Out of the 115 dictionary consultations undertaken by our ten subjects, there were 49 cases (21 in Group 1 and 28 in Group 2) where the dictionaries were consulted by the subjects but were felt to give no assistance. These were excluded from consideration, since the fact that the students felt that they derived no help from the dictionaries meant that they had to rely on their own L2 resources, just as in the case of units for which the dictionaries were not consulted at all. Sixty-six units remained for which the think-aloud protocols indicated that the students felt the dictionaries were profitable. It transpired that 29 of these involved consultations for which a correct solution had either been retained or changed into another correct solution; in 11 cases an error had been retained or changed into another error. Hence in none of these 40 cases could the use of dictionaries be said to have significantly changed the quality of the product.

Thus, there were only 26 instances where consulting a dictionary changed the quality of the product, either positively or negatively. Five of these resulted in unsatisfactory and 21 in satisfactory solutions.[7] If we take into account that nine of the changes from an incorrect to a correct solution were simple spelling corrections, and that these could have been dealt with by a spell checker had this been available in *Translog*, we are, surprisingly, left with a mere twelve quality-improving instances (see Hypothesis 4).

On examining these 12 units more closely, only seven prove to be straight-forward. In one case a student was convinced that the dictionary had helped him to arrive at a solution to a problem – even though the phrase in question was not actually to be found in the dictionary concerned! Four other corrections (produced by different individuals) involve the same cultural transfer problem – one which cannot be solved by means of a dictionary. Denmark has coalition governments with ministers coming from several different political parties. Danish newspapers therefore invariably add ministers' party affiliations to their names by means of a letter enclosed in parentheses – in this

particular instance: Niels Helveg Petersen (R).[8] The four students in question looked up the name of the party in the Danish-English dictionary, hence superficially translating the unit correctly, but not realising that in this specific context, where the focus is on Petersen speaking in his capacity as Danish foreign minister, any mention of party affiliation is irrelevant. Indeed, it could even prove confusing to the target text reader, who might search the context – in vain – for the reasons behind the provision of such additional information. Consequently, there are at best seven genuine quality-improving consultations. Set against the background of 115 units involving dictionary consultations and 241 verbalised units in all, the results can justifiably be considered thought-provoking.

Pedagogical implications

The following pedagogical conclusions can be drawn from our study.

– Students have insufficient confidence in their own linguistic abilities. They therefore overuse dictionaries for non-domain-specific translation tasks by looking up units for which they have already found one or more adequate solutions without consulting them;
– Students focus too narrowly on lexical units at the expense of other important factors such as situational and textual context.

The first point can be illustrated by means of the following example. In the sentence *The Foreign Minister finds that it is entirely up to China to decide how to re-establish the good relationship*, Dina is uncertain as to how to render Danish *det er op til Kina....* She says: 'it is tempting to write something like *up to China...*'. Oddly enough, she immediately rejects this solution because, as she says, 'you would not write that in a newspaper' (a peculiar argument seeing that the text quotes what the minister actually *said).* After 2m. 30s. deliberation she eventually changes it into an equally satisfactory solution (*it is for China to decide ...*), and then returns to the problem twice more during Experiment 1. On both occasions, Dina expresses irritation with her translation, which she nevertheless eventually retains as her final solution in Experiment 1. When given access to dictionaries in Experiment 3, she immediately consults the dictionary without finding anything to help her. She continues to deliberate for another 2 m. unable to choose between *it is for China to find out* and *it is for China to figure out*. Dina finally opts for *find out,* after which she returns to the problem yet again on two more occasions. Both times she worries about the

inadequate *find out solution, which she realises is not completely satisfactory, but she hangs on to it nevertheless. Thus she has spent no less than 9m.10s on a unit for which her first spontaneous solution was adequate, and eventually succeeds only in producing an error.

There is no clear correlation between time spent on the translation and quality of the product. For instance, three students achieved an 'average' mark taking 43 m., 79 m. and 98 m. respectively; one achieved a 'good' grade taking 63 m.; and of the students who spent most time on the task (112 m. and 101 m. respectively) the first scored a little below average, whereas the other achieved a grade of 'excellent'.

Our second conclusion – that students focus too narrowly on lexical units – is a well-known fact, but the study shows that it remains a serious problem which has to be tackled (see also Livbjerg 1999b: 276). The pointless inclusion of the then foreign minister's party affiliation that we mentioned earlier is an example of such complete disregard of situational context.

Another result of the narrow concentration on lexical units is that not enough attention is paid to the problem of reference – a matter that should perhaps receive more focus in translation teaching. For example, the Danish source text has several references to the Danish foreign minister. Sometimes he is referred to by name alone (*Niels Helveg Petersen*); sometimes by title alone (*Udenrigsministeren*, i.e. 'the foreign minister'); and sometimes by both (*Udenrigsminister Niels Helveg Petersen*, i.e. 'Foreign Minister Niels Helveg Petersen'). All ten subjects spent time pondering the spelling and/or the term for 'foreign minister', but almost all ignored the problem of reference: although 'the foreign minister' and 'Niels Helveg Petersen' would unambiguously mean the same person to Danish readers – irrespective of the reference chosen – the target text readers (not being at home in the world of Danish politics) might be in doubt as to whether the text referred to one or two individuals. This would be the case if a subject, for instance, wrote: *Denmark will not apologise to China … This was the reaction of the Danish foreign minister the day after Denmark's critical resolution had been rejected by the UN Commission on Human Rights … Niels Helveg Petersen thinks that it is entirely up to China to re-establish the previous good relationship between the two countries.*

Conclusion

We believe that by letting students translate texts under conditions similar to the present study, and then proceeding to discuss their translation behaviour

and strategies with them, translation teachers can give valuable advice to individual students, geared to their specific needs (cf. Lorenzo 2001). It is important to emphasise this need for individual advice. Our examination of the protocols has revealed that the subjects do indeed possess individual combinations of abilities and strategies. Hence they exhibit different combinations of strengths and weaknesses which may to a large extent have to do with personality factors (see also Krings 1986: 34; Livbjerg 1999a: 219; Livbjerg & Mees 2002: 172–176; and Hansen, this volume). Our focus on the 26 quality-changing cases in the present paper does not imply that the rest of the verbalised units do not merit further investigation. In terms of providing information about students' strategies for problem solving, and for the type of advice to be given to each student, they are at least as interesting as the 26 units selected. However, even the present investigation indicates that if students are individually shown how far they can trust their linguistic L2 competence most can save considerable time when translating without any sacrifice of quality.

Notes

1. We are grateful to our CBS colleague Arnt Lykke Jakobsen, Beverley Collins (University of Leiden, the Netherlands) and two anonymous reviewers for helpful suggestions and comments on drafts of this chapter.

2. Ll-L2 translation training is important in Denmark since this type of work is carried out probably just as frequently as L2-L1 translation. Such a situation is quite usual in small-language communities where there are not enough native speakers of the target language who also have a good command of the source text language; cf. Campbell (1998: 27) who describes translation labour market forces in Finland.

3. 'Significantly' (improved) here means changing a solution from being incorrect to correct as opposed to changing a correct solution into another correct solution.

4. Like Krings (1986: 113), we too find that the interpretation of what constitutes a translation problem for a subject leaves us with a fuzzy problem/non-problem borderline. Our somewhat more inclusive interpretation of what constitutes a problem may account for the lower percentage of dictionary use in our data as compared with Krings's (see Hypothesis 2).

5. The calculations presented here and elsewehere in this article are based on the figures in Tables 4a, 4b, 7a and 7b in Livbjerg and Mees (2002: 185–186, 189–190).

6. The higher number of consultations in Group 2 can possibly be explained by the fact that for 13 units students resort to the dictionary immediately without suggesting a possible translation first. These cases are recorded as quality-changing, because they transform the unit from a zero solution to either a correct or an incorrect solution. In seven of these instances, dictionary consultation resulted in an error; the remaining six led to a correct

solution. In contrast to our findings (only 13 out of 64 cases), Krings (1986) discovered spontaneous look-ups to be a typical strategy with his subjects.

7. Some of these 'changes' were in fact changes from no solution at all: the dictionary was resorted to immediately in these cases in Experiment 2 before any translation of the unit had been attempted. Cf. Footnote 6, which refers to the figures for *all* changes from zero solution for which the dictionary was consulted, including those where the dictionary was thought to provide no help.

8. The abbreviation stands for 'det *Radikale* Venstre', literally 'the Radical Left', which in spite of its name is in fact a centrist party (the official English translation is *Danish Social Liberal Party*).

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Appendix

Danish source text and a possible English translation

Bodsgang er udelukket

'Danmark vil ikke gå bodsgang over for Kina. Det ligger ikke lige for. FNs menneskerettighedskommission er til, for at landene kan drøfte menneskerettighederne.'

Sådan lød kommentaren fra udenrigsminister Niels Helveg Petersen (R) 'dagen derpå' – dagen efter at Danmarks Kina-kritiske resolution blev afvist i FNs menneskerettighedskommission.

Udenrigsministeren mener, at 'det er helt op til Kina', hvordan forholdet mellem Danmark og Kina skal blive godt igen. 'Vi håber, at vi med hele denne debat, der er skabt om resolutionen, kan inspirere til, at menneskerettighederne forbedres – til at der sker fremskridt på dette område,' siger udenrigsministeren.

På et spørgsmål om hvorvidt Niels Helveg Petersen opfatter Kina som åben over for kritik af menneskerettighederne, siger udenrigsministeren, at Kinas reaktion har været barsk i hele procedurespørgsmålet i menneskerettighedskommissionen.

Apology out of the question

'Denmark will not apologise to China. That is not under consideration. The whole purpose of the UN Commission on Human Rights is to allow countries to discuss human rights.'

This was the reaction of Danish Foreign Minister Niels Helveg Petersen 'the morning after' – i.e. the day after Denmark's critical resolution had been rejected by the UN Human Rights Commission.

The Foreign Minister found that 'it is entirely up to China' how to re-establish the previous good relationship between Denmark and China. 'We hope that the debate initiated by the resolution will inspire an improvement of human rights and lead to progress in this area,' Mr Petersen said.

Asked whether he considered China to be open to criticism on her human rights, the Foreign Minister said that China's reaction to points of procedure had been unaccommodating.

Using think-aloud protocols to investigate the translation process of foreign language learners and experienced translators

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This article outlines the trajectory of the PRONIT research group, based at Universidade Federal do Rio de Janeiro, Brazil. The group has done research into the translation process of foreign language learners and experienced translators, using the think-aloud protocol methodology, in the monologue and dialogue modes. The article describes how the group arrived at its basic tenet, the translation flow, which has been used as a cornerstone in its research design. The article further exploits how the group has refined its methodology as its work has progressed, in an attempt to offset the difficulties in assessing the translation process which are inherent to the methodology. The group's preliminary findings are discussed. These concern the translation problems of foreign language learners and the problem solving strategies employed by both foreign language learners and experienced translators, working alone or in pairs. A brief attempt is made to compare the findings for the two groups.

Introduction

In 1993 we created an interdisciplinary research group at the Federal University of Rio de Janeiro (UFRJ), headed by Prof. Angela Corrêa, aiming at analysing the translation process of both foreign language (FL) learners and experienced translators working from English or French into Portuguese. Our original goal was to detect, describe and explain the kinds of problems our undergraduate students majoring either in English or French faced when they first attempted to translate a text without having had any formal training in translation, and to observe what steps they took to solve such problems. In our project's next phase we intended to carry out the same research with professional translators and,

finally, to compare our findings for both sets of translators, which, we thought, would eventually enable us to devise a framework for the formal training of translators based on what we perceived to be the most striking differences between the two groups' translation processes. Since the focus of our research was the translation process, rather than the translation product, we decided that Verbal Protocol Analysis was the most appropriate methodology for our intended goals.

When we set up our research project we aimed at involving both undergraduate and graduate students, who acted as research subjects and assisted us throughout the different research stages. At the beginning of the academic year, each of the three senior researchers in the group, assisted by a graduate student, would select two undergraduate students to take part in the research project under their supervision, as recipients of student-research grants. Whenever possible, the students in the FL classes we taught (10–25 students each) would be asked to agree to be used as research subjects (cf. Anjos 1999; Cunha 2002). All of the students formally engaged in the research group were able to use the data we gathered as a basis for their own academic output.

So far we have not been able to implement a formal Translator Training Program at UFRJ, but our efforts have laid the foundations for specific areas of research in two of our Graduate Programs: Applied Linguistics and French Language and Literature (cf. Barbosa & Neiva 1997). A few master's and doctoral theses have already stemmed from this project (cf. Martins 1996; Araujo 2000; Sacramento 2001; Cunha 2002; Santos 2002) and some are well on their way to completion.

The translation flow and the translation unit

The first few verbal protocols that we produced, as try-outs, or as our own training in the methodology, led Prof. Angela Corrêa (cf. 1994) to develop a concept also found in Séguinot (1989) and Ballard (1996): the translation flow. Since then, this concept has served as a foundation for our research design. It is suggested that the translation flow runs from the point where the translator starts reading the source text to the point where the translator stops reading in order to start translating. Each length of text processed makes up a translation unit, so that it can be considered that each translation unit is demarcated by a break in the translation flow. Breaks may occur simply because the amount of text involved is all that the translator's brain can process at a time, or they may occur because those are the points at which the translator found difficulties,

either because there is a vocabulary item that has to be looked up or because the syntax is too involved for immediate understanding or processing.

With that in mind, we examined the translation units described by Gerloff (1987) and Barkhudarov (1993), and checked them against the translation units found in the verbal protocols produced by two sets of two second-year students doing translations respectively from English and French into Portuguese. We found that most interruptions of the translation flow occurred at the phrase level, followed by the clause level, then by the single word level and, finally, by the level of units with no syntactic meaning. No units were as long as the sentence or the paragraph (cf. Cunha da Silva 1996).

When those findings were compared to the results obtained later when analysing the verbal protocols of two sets of two third-year students doing translations respectively from English and French into Portuguese (more advanced students), it became apparent that they employed longer translation units, sometimes as long as the sentence. Fewer of the units they employed consisted exclusively of single words and none consisted of non-grammatical units. This difference may be explained by the fact that those students' language skills were much better than those of the students making up the first group (cf. Guimarães 2000).

Foreign language learners as translators

Although it was possible to obtain such preliminary results, using our students as research subjects has posed some intricate methodological problems. Firstly, our undergraduate students can only be classified as FL learners whose linguistic abilities have not been developed to the full, reaching a higher intermediate level at best. The vast majority have never been abroad, and even those who do go abroad may spend most of their time with other Brazilians, speaking Portuguese, as they usually travel in tourist groups. Moreover, because there is no translator training program at UFRJ, it is not possible to classify our students as translator apprentices, or even as beginner translators, particularly as the translations they do for our research are often their first attempt at translation work.

It is well-known that the scholars who initially thought of introspection as a way of delving into the translation process (cf. Faersch & Kasper 1987) were in fact FL teachers using translation as a means of testing, or perhaps, evaluating, language acquisition, as has been done for over two thousand years in the tradition of the grammar translation method. It is this aspect that makes

it necessary to discuss who the research subjects are, and what kinds of insights into the translation process can be obtained from them.

Since, owing to circumstances, our research subjects are primarily FL learners, we took into account several points established by research carried out elsewhere: that, for instance, FL learners who have only a basic command of the FL often look at the text word for word, and often break the text up in nonsensical units because they cannot really make sense of the text.

Our data has revealed that our undergraduate students often translate in order to be able to understand a text. They seem to approach a text in the FL rather like Champollion did the Rosetta stone, trying to break a code, to decipher a text. They do not seem to approach the text as something they can read, understand and perhaps even enjoy, and then recreate in their own language. They seem to have little concern for the fact that translating is producing a readable text in the target language, not plodding through a text dictionary in hand. It has appeared to us that this reflects how language learners read or deal with texts, not necessarily how professional or experienced translators work, or even how a translator's mind works.

Such considerations have led us to arrive at the conclusion that the vital questions to be answered by research into the translation process are: How do the mental processes of a professional translator differ from those of someone who is going through the process of language acquisition? Do the answers we arrive at by examining FL learners apply to the translation process or to the learning process? Does the translation process differ between someone who has an excellent active command of the language, and someone who has trouble understanding a text in that language?

Refining the use of monologue protocols

With such questions in mind, we have made several attempts to refine our research methodology, first of all concerning our experiments with our undergraduate students, aiming at overcoming our circumstantial drawbacks, and later applying the same principles to experiments with experienced translators.

In order to further explore the translation process of FL learners, we continued to apply the think-aloud technique to elicit concurrent verbal reports. At this stage we tried, as much as possible, to eliminate other-oriented verbalizations from the experiment and, at the same time, to create an environment without potentially intimidating factors that might disrupt the process. We tried to minimize the negative influence of the elicitation technique itself in

the subject's cognitive processes, since this has been one of the several criticisms raised against think-aloud protocols in translation research.

In order to do so, sessions were held with the students, in which they were trained in the think-aloud technique, following the suggestions of Ericsson and Simon (1987). Warming-up procedures were carried out in which the senior researcher acted essentially as a monitor, coaxing the students to speak whenever there were long periods of silence. Because the researchers held the powerful position of both professors and supervisors, it was necessary to test whether or not their presence interfered with the subjects' state of mind to a point of intimidation.

It was decided, therefore, that the subjects would be made to attempt to do the think-aloud protocol in two different set-ups. The first was an unassisted think-aloud protocol, i.e., the students would record their verbalizations while doing the translation of an academic text extracted from an introduction to linguistics manual on an audiotape. They would do so according to the procedures they had rehearsed previously, that is, they would do a verbal report of their ongoing thought processes while carrying out the translation task without a senior researcher present. The second experiment, carried out with a different text, from the same textbook, involved a senior researcher's presence not only to act as a monitor, intervening to remind the subjects to think-aloud whenever they paused for longer than approximately five seconds, but also to take notes during audio recording sessions.

Two post-process elicitation techniques would also be applied which, together with the think-aloud data, would make triangulation possible. The first would be immediate retrospection, resorted to during the translation process, whenever the subjects' spontaneous verbalizations did not make it clear why the translation flow was interrupted. The second, delayed retrospection, would be carried out a week later during the transcription of the concurrent verbal protocol.

The subjects, acting as both our informants and our assistants, would listen to the tapes containing the think-aloud protocols in order to transcribe them and would provide additional information or make further comments on their difficulties while translating the text, whenever their spontaneous comments or their response to our interventions were not clear enough. It was expected that, although more potentially disruptive to the translation process than the first, the second procedure would be more revealing as far as the focus of our research was concerned.

Apart from testing the effectiveness and naturalness of the elicitation procedures themselves, it was also important to find out whether the FL students

were able to describe the type of problem they were facing whenever they interrupted the translation flow, and note the strategies used to solve them. To our surprise, however, the subjects exhibited a similar kind of behaviour in both situations. Their spontaneous verbalizations in the unassisted think-aloud protocol provided substantial information about their thoughts while they faced a variety of difficulties throughout the process, but at times they failed to express unequivocally the origin of the problem they were facing while going through the translation process. In order to identify the type of problem faced in those situations, it was necessary to resort to delayed retrospection although this technique poses problems of its own, such as ex-post rationalization, as pointed out by Ericsson and Simon (1987).

In the assisted think-aloud protocol situation, one of the subjects provided as much spontaneous verbalization as in the first case, while researcher intervention had to be resorted to in relatively few instances. The data resulting from delayed retrospection and from the subject's comments, made either spontaneously or in response to queries in immediate retrospection, allowed cross-references to be established. As far as this subject is concerned, although the use of the three techniques yielded a clearer, more detailed picture than that provided by the application of the unassisted think-aloud protocol alone, it is possible to say that comments spontaneously generated by the subject were very revealing, thus demanding less intervention on the part of the researchers than originally expected.

However, the verbal protocols elicited from another subject yielded quite different results. Even though the two students' backgrounds were similar as regards translation experience and linguistic competence in English, their reactions to the application of the think-aloud technique were very different, thus demanding different degrees of intervention. This informant found it less natural than the other to verbalize his thoughts while trying to solve challenging problems, in spite of the fact that he had also been previously trained in the think-aloud technique. Because his spontaneous comments during his concurrent verbal protocols were not very informative, frequent interventions on the part of the researcher became necessary to elicit data that would clarify the source of his difficulties. Immediate retrospection was, therefore, a technique resorted to in order to define the types of problems this subject encountered.

Contrary to the general belief that interventions inevitably disrupt the cognitive processes of subjects submitted to think-aloud procedures, as argued by Krings (1987: 162), in general the subjects responded to the researcher's queries without signalling that those interruptions affected their thinking processes,

except for one instance: at the beginning of a recording session, the a subject explicitly complained about interruptions by saying in Portuguese: "Ah, where was I? ... You disturbed me here...". Nevertheless, concurrent verbal protocol data, together with data obtained by means of immediate retrospection, enabled us to determine the origin of most problems the subjects encountered during the experiment. As in other protocols, delayed retrospection was an important tool to further explain and define the problems these subjects faced during the translation process and allowed us to confront the delayed retrospection data with those obtained either spontaneously or by means of immediate retrospection.

The experiments provide evidence that different subjects, with similar backgrounds, may react differently to the use of think-aloud protocols, of immediate and of delayed retrospection, thus generating sets of data with varying degrees of naturalness, spontaneity and, therefore, reliability. It is our contention that such idiosyncrasy and subjectivity should be taken into consideration when designing empirical research that aims at investigating the translation process by means of introspective techniques. It is for this reason that we suggest that subjects should be exposed to a training phase allowing for experimentation with more than one elicitation procedure. This would give the researcher the opportunity to analyse the subjects' reactions and behaviour before deciding how much intervention is required in order to elicit relevant data while avoiding, as much as possible, disrupting the subjects' cognitive processes.

Another conclusion that may be drawn from the verbal protocols we have analysed so far is that a combination of elicitation procedures is desirable because each generates a different set of data, and those can be triangulated. Since think-aloud protocol analysis is based primarily on the subject's own perspective of what goes on in his or her mind during the translation process, triangulation of the data obtained by the application of the think-aloud technique with those collected by means of retrospective elicitation procedures would produce a more reliable picture of what occurs during an individual's translation process.

This picture can be further complemented by the confrontation of introspective data with empirical observations of the subject's nonverbal behaviour registered on videotape or in detailed field notes taken by the researcher together with an analysis of the drafts made for the translation product.

Translation problems of FL learners

Since our preliminary research allowed us to perceive that there were three major kinds of difficulties that our student-subjects faced when translating, we decided to make this issue our focus of attention at this stage of our investigations. These problems are:

1. understanding the source text – apparently the most common problem for FL learners;
2. refining the target text – after having understood the source text's translation unit and written down a preliminary translation for it, the FL learner focuses his or her attention exclusively on the target text he or she has just produced in order to improve his or her target text; and
3. finding the means to express in the target language what the FL learner understood while reading the source text's translation unit – having found difficulties in expressing him or herself, the student's attention seems to remain focused on the source text even while he or she seeks a solution in the target text language: at this moment, therefore, the student hovers between languages, without being able to make a decision (cf. Corrêa & Neiva 2000: 37).

The following examples illustrate each of these kinds of problems.

> Type 1: Understanding the source text
>> Source text: "The very word slang summons up images of four-letter words, of sloppy speech"
>> Subject talks aloud while reading source text: [pause] "Of sloppy speech" [pause] sloppy [pause] *não sei o que que é*
>> Gloss: [pause] "Of sloppy speech" [pause] sloppy [pause] I don't know what it means
>> Subject (consulting dictionaries): "Cause something to" [pause] vou procurar no [pause] *inglês-português* [pause] "*se um líquido slops ou você slops um líquido ele, ele derrama da beirada de um recipiente salpicando o chão*" [pause] *não entendi, não tem nada a ver* [pause] "*algo que é sloppy é desajeitado e sem cuidado*"
>> Gloss: "Cause something to" [pause] I'll look it up in the [pause] English-Portuguese [pause] "if liquid slops or if you slop it, it spills over the edge of a container in a messy way" [pause] I don't understand; it has nothing to do with it [pause] "something that is sloppy is careless, messy"

Subject continues talking aloud: *Um discurso* [pause] *desajeitado, sem cuidado, um discurso informal, alguma coisa assim*

Gloss: Discourse [pause] awkward, careless, informal discourse [pause] something like that

Subject rereads target language text: "*De quatro letras*"

Gloss: "Of four letters"

Subject rereads source text: *De* "*sloppy speech*" [pause] *de discurso informal* [pause] *vou colocar entre aspas*

Gloss: Of "sloppy speech" [pause] of informal discourse [pause] I'll write it between quotation marks

Subject writes: "*De discurso informal*"

Gloss: "Of informal discourse"

Type 2: Refining the target text

Source text: "Often a word or expression that has an origin in a jargonistic sense escapes from that context into general use"

Subject reads source text aloud: "Often a word or expression that has an origin"

Subject talks aloud: *Freqüentemente uma palavra ou expressão* [pause] *tem muito freqüentemente aqui, mas* [pause] *freqüentemente, com freqüência* [pause] *já usei com freqüência também* [pause] *vou colocar freqüentemente* [pause] *poderia dizer de outra forma* [pause] *não* [pause] *não raras vezes* [pause] *não raras vezes não é freqüentemente* [pause] *deixa eu ver se tem no dicionário, eu acho que não…*

Gloss: Frequently a word or expression [pause] there are too many instances of frequently here, but [pause] frequently, often [pause] I've also used often [pause] I'll write frequently [pause] I could say it in a different way [pause] no [pause] not rarely [pause] no, not rarely is not the same as frequently [pause] let me look it up in the dictionary, I don't think...

Researcher: *Por que que você não quer freqüentemente?*

Gloss: Why don't you want to use frequently?

Subject answers: *Porque eu já usei várias vezes* [pause] *com freqüência, freqüentemente* [pause] *aí fica meio* [pause] *tô procurando…*

Gloss: Because I've used it many times [pause] often, frequently [pause] it gets kind of [pause] I'm looking…

Subject talks aloud: *Muitas vezes* [pause] *é* [pause] *muitas vezes* [pause] *melhor* [pause] *muitas vezes*

Gloss: Many times [pause] yeah [pause] many times [pause] better [pause] many times

Subject writes: "*Muitas vezes*"

Gloss: "Many times"

Type 3: Finding the means to express in the target language what the FL learner understood while reading the source text's translation unit

Source text: "The context can also refer to a set of shared interests among the participants in a conversation or more generally in a situation in which there is sustained contact among people"

Subject rereads source text: Ah [pause] "to a set of shared interests"

Researcher: *Qual é o seu problema?*

Gloss: What is the problem?

Subject answers: *Ahn* [pause] "to a set" [pause] *o quê?* [pause] *como é que fica?*

Gloss: Huh [pause] "to a set" [pause] what? [pause] how does that go?

Researcher: *Qual é o teu problema?* [pause] *Como é que…*

Gloss: What is your problem? [pause] How do you…

Subject talks aloud: "To" [pause] *complicou* [pause] "to a set [pause] of shared interests" [pause] *também pode se referir a um grupo*

Gloss: "To" [pause] now what? [pause] "to a set [pause] of shared interests" [pause] it can also refer to a group

Researcher: *Qual é o problema aí? Que que você tá...*

Gloss: What is the problem there? What are you…

Subject talks aloud: "Set"

Researcher: "Set" *que cê?...*

Gloss: "Set" that's what you're?...

Subject talks aloud: *Um conjunto*

Gloss: A set

Researcher: *Que tá pegando?...*

Gloss: What's the problem?

Subject talks aloud: *É* [pause] *um grupo* [pause] *de interesses comuns*

Gloss: Hm [pause] a group [pause] of shared interests

Researcher: *Você tá procurando sinônimos ou tá…*

Gloss: Are you looking for synonyms or are you…

Subject answers: *Tô querendo ver qual seria o* [pause] *melhor uso* [pause] *em português pra isso* [pause] *porque pode se referir a um grupo* [pause]

> *de usos comuns* [pause] *a um* [pause] *conjunto* [pause] *acho que conjunto* [pause] *se referir a um conjunto*
>
> Gloss: I'm trying to see what would be [pause] the best use [pause] for this in Portuguese [pause] because it may refer to a group [pause] of common usage [pause] to a [pause] set [pause] I think set [pause] may refer to a set
>
> Researcher: *O problema é só o "set"?*
>
> Gloss: Is the problem only the word "set"?
>
> Subject answers: *É* [pause] *conjunto* [pause] *nesse contexto, né?* [pause] *a um conjunto de informa… de* [pause] *interesses* [pause] *comuns*
>
> Gloss: Yeah [pause] set [pause] in this context, ain't it? [pause] to a set of informa…, of [pause] common [pause] interests
>
> Subject writes: "*A um conjunto de interesses comuns*"
>
> Gloss: "To a set of shared interests"

A fourth category of problem was detected: a momentary lack of attention. The FL learner may realise that he or she has made a mistake, and goes back to correct it. This error is not ascribed by the subject to lack of knowledge or failure in understanding the source text; instead, it is perceived as being due to an external factor: a distraction, or what is verbalized as being a momentary lack of attention which results in an interruption of his or her train of thought (cf. Marques 1999).

> Source text: "originally a technical term in reference to business reports"
>
> Subject rereading the target text: *É* [pause] *originalmente um termo técnico que se refere a textos* [pause] *comerciais*
>
> Gloss: Hm [pause] originally a technical term that refers to commercial [pause] texts
>
> Subject talks aloud: *Não, não é nem textos, é reports* [pause] *é relatórios comerciais* [pause] *falta de atenção, foi isso*
>
> Gloss: No, it isn't even texts, it's reports [pause] I wasn't paying attention, that's what happened

This category of problem also became apparent during delayed retrospection sessions. When asked to explain particular choices, especially those that seemed to be inappropriate, FL learners sometimes ascribed them to a momentary lack of attention, perhaps in an attempt to save face. An example is the translation of the term "four-letter word" as "a word of four letters", instead of "a swear-

word," in the first example of problem presented above, which received this explanation from the subject during delayed retrospection.

Translation problem solving by FL learners

Our experiments have enabled us to tentatively note a few features of the problem-solving process of FL learners, which can be briefly summarized as follows:

–   A problem belonging to a specific type may develop into another problem, of a different type;
–   In the problem-solving process, a strategy may trigger another one if a solution is not found, if the solution is deemed unsatisfactory, or if it requires confirmation;
–   Both chain and parallel problem processing may occur;
–   Strategies are multifunctional: the same strategy may be used to solve different types of problems;
–   Macro-textual analysis is rarely applied; instead, micro-textual analysis is employed focusing primarily on lexical items and, less frequently, on grammatical structures (cf. Magalhães 2000a, 2000b);
–   Internal search, such as inferencing, is resorted to, but, when a solution is found by means of this strategy, FL learners tend to feel the need to corroborate them with external searches, mainly by using a bilingual dictionary;
–   The most frequent external search strategy is the use of bilingual dictionaries, rather than monolingual ones;
–   A literal translation of individual lexical items or short stretches of text may function as a cognitive strategy to solve comprehension problems.

Professional translators

In order to analyse the translation process of professional translators, it was arranged for three women in the 45–55 age range, having the same educational background, to agree to become research subjects. These translators appear to typify the professionals active in the area in Brazil, as evidenced both by informal oral reports at the translators' union and by audience reaction when such facts are mentioned: few have had training of any kind, most did not learn

their foreign languages in the university context, their first degrees tend to have been in something other than modern languages. Additionally, most Brazilian translators, according to the union, work from home, as do the translators that were investigated. In order to make the verbal protocol situation as natural as possible, the experiments were carried out at their workplace.

In an attempt to optimise the data gathering process and allow for triangulation, the professional translators were submitted to a variety of procedures. They were initially submitted to semi-structured audio-tape-recorded interviews which made it possible to obtain more detailed information about their backgrounds, their experience and their views of translation. These also served to *break the ice*, as it were, since professional translators, too, may be intimidated by the presence of a researcher, particularly when he or she is well-known in the community. The subjects were also trained in the methodology, by being asked to undergo a warming-up process. They were also submitted to delayed retrospection, which was carried out by asking them questions about what had happened during the tape-recording of the verbal protocol, as based on the researcher's notes. Such notes also proved valuable at the tape transcription stage, which, unlike our experiments with our own students, could not be aided by the subjects themselves (cf. Barbosa 1999).

Carrying out the experiment at their work environment not only served as an additional preventive measure to ensure naturalness and spontaneity in the verbal reporting but also made it possible to note several of the translators' work methods, such as computer use, data basis construction and so on, but not much progress has been made as regards assessing their cognitive processes. As other researchers have noted, there are difficulties inherent in doing introspective research with professional translators. Even though translation is considered an ideal task for oral protocols (unlike reading, for example) because it is typically a task with many interruptions, and sometimes even verbalizations, thinking aloud does not come easily to professional translators. It is distracting for them, and they work much faster than FL learners do, which forces the researcher to interrupt them more frequently so as to obtain data.

Because their thinking processes sometimes appear to be faster than it is possible to type, by the time the researcher asks them to explain the reasons why they have done something, they are already doing something else and have trouble verbalizing what has gone on before. Even though their body language reveals that something is going on in their minds, and the tape recorder may register a deep sigh or a pregnant pause, the explanations given, after prompting by the researcher, rarely produce valuable insights. This, of course, is a drawback in the methodology, something that has been challenged by

translation theoreticians such as Toury (1995). The question remains whether we can really have access to someone's thought processes, particularly when many of those processes have become automatic, therefore not necessarily surfacing to the conscious mind.

Additionally, it was possible to corroborate what other researchers using professional translators as subjects have already found: that, contrary to what the vast majority of translation teachers say, professional translators do not read the whole text before starting to work. The reason given is that they are pressed for time, have deadlines to meet, and therefore cannot waste precious time. What became apparent was that professional translators made up for that lack in several ways, resorting to macro-textual analysis, i.e., strategies aimed at recognizing genre, rhetorical patterns and contextualisation clues (cf. Magalhães 2000a). First, they took into account many extra-textual clues, such as illustrations, layout and formatting. They also hypothesized aloud about the text; that is, they made content predictions on the basis of text type and previous experience. The text used for the experiment ("Firms that never sleep") was taken from a news magazine and focused on a new work technology (telemarketing 48 hours a day from several points of the globe), unknown in Brazil at the time, on the premise that professional translators usually have to cope with the new (cf. Barbosa & Caldas 2002). Before starting the actual translation work, they made comments about the text's genre (news magazine), carefully examined the illustrations, and created hypothesis about the text's content on the basis of the information gathered.

FL learners, in common with professional translators, neglected to read the text beforehand. But, unlike the professionals, they neither made predictions nor examined para-textual material. FL learners appear to translate a text as a continuous operation, working from top to bottom and considering the task done when they reach the full stop. Professional translators, on the other hand, seem to make up for a lack of previous reading by moving back and forth in the text continually, reserving decisions to be made later, going back up to make corrections – as when, for example, a lexical item is repeated too often, which is not acceptable according to the current stylistic norms of Brazilian Portuguese (such norms are so widely accepted that even FL learners are aware of them, as shown in the example given for the second type of translation problem above). Professional translators also want to reread the whole translated text when they reach the end, sometimes even delaying revision till the following day, as mentioned by one of the translators: "*eu normalmente tento fazer o trabalho num dia e fazer revisão no outro* [pause] *no dia seguinte*" [I normally try to do the work one day and do the revising on the other [pause] the next day]. They

tend to consider that a translation is never definitive – except for the fact that there is a client expecting a piece of work to be delivered to them on time.

Using dialogue protocols

Our next attempt in overcoming the methodological difficulties inherent in monologue protocols was to obtain what are known as dialogue protocols, in which two or more subjects complete a translation project together, as described by Kussmaul (1995) and Séguinot (1996). The first experiments were carried out with pairs of undergraduate students (cf. Anjos 1999).

The data did not differ greatly from the results obtained before as far as the features of the problem-solving process of FL learners are concerned, but they made it clear that indeed more data could be obtained when two people working together had to negotiate in order to decide whose solution would be implemented. The most striking feature in these think-aloud protocols, however, was that the dominating personalities would be in command of the negotiation, even though their solutions might not be the best, or might sometimes even be the less adequate ones.

In order to start checking our FL learner data against those of professional translators, we took advantage of the fact that two graduate students in the Applied Linguistics Program were professional translators, and set up an experiment using them as subjects. These two students had never worked together before, and were asked to carry out the task of translating a text in collaboration in a work environment quite different from their respective usual ones. This, however, did not seem to influence negatively in the process, which progressed within a cooperative framework toward the subjects' main objective: to find the best solution for the problems posed by the source text. In order to attain their goal, one prompted the other, options were confronted and compromise was reached by the translators in a natural and spontaneous fashion. The researcher's role was limited to controlling the tape recorder and to taking field notes about the subjects' behaviour and other relevant data that might help in the transcription and analysis of the verbal protocol.

Apparently, owing to the fact that dialogue protocols are derived from a collaborative endeavour, being, therefore, other-oriented, as argued by Kussmaul (1995) and Séguinot (1996), they do not necessitate much researcher intervention. Unlike the monologue situation, in which lack of spontaneous verbalization of the subjects' cognitive processes call for triangulation more forcefully, the dialogue protocol, owing to its very interactive nature, compels

the subjects involved to express, comment on and even justify their strategies in the process of negotiating solutions for problems without the need for external intervention or prior training in the think-aloud technique.

This does not mean, however, that dialogue protocols alone provide all the data that are needed for describing and understanding what goes on in the translator's mind or that they are completely reliable as far as revealing the translator's thought processes. The fact that the subjects have to go through negotiation procedures in order to complete their task may lead to what Kussmaul (1995) calls the "danger of after-the-event rationalization"; that is, a subject, confronted with a request from his or her partner to explain a specific solution, might be tempted to find arguments to support his or her solution that were not taken into consideration when the subject first thought about it. Also, according to Kussmaul and as was evidenced in the data we obtained with FL learners, there is another potentially negative aspect that needs to be considered: one of the subjects may become a leader due to personality traits and act in an overbearing fashion, thus preventing the other subject from expressing his or her thoughts freely (1995: 11–12).

In order to counteract the effects of these potentially disruptive factors when investigating experienced translators, post-process elicitation procedures were carried out, such as delayed retrospection, thus obtaining data from each subject individually, which were triangulated with the dialogue protocol itself and the field notes taken by the researcher. This triangulation made it possible to pinpoint the moments when, for example, one of the subject's leadership tendency inhibited the other in the negotiation of a solution to a specific problem. Although instances of such preponderance of one over the other were in fact detected, as a whole their negotiation was marked by cooperation and compromise.

Because of the naturalness and spontaneity characteristic of dialogue protocols, identifying translation problems required no intervention on the part of the researcher. When faced with what they perceived as a problem, the only way the subjects were able to find a solution in the dialogue situation was to share and discuss their difficulties with each other. In this way, this dialogue protocol together with retrospective reports by each subject have produced some interesting insights into the problem-solving process of professional translators, some of which are similar to those of FL learners. Although such results are only preliminary, they can be summarized as follows:

– The three major categories of problems are clearly identified: understand- ing the source text, refining the target text, and finding the means to ex-

press in the target language what the translator understood while reading the source text's translation unit;
- A problem of a specific type may develop into another, of a different category;
- The following strategies surface spontaneously: macro-textual and micro-textual analyses; external and internal search strategies;
- The strategies detected are multifunctional and are usually applied in a variety of combinations to solve a single problem;
- Both chain and parallel processing of problems may occur;
- Most problems encountered are problems in refining the target text;
- Bilingual dictionaries are rarely consulted;
- Though only monolingual dictionaries are actually used, a variety of external search strategies are alluded to as useful tools for the solution of problems;
- The most frequently activated strategies are internal search and macro-textual analysis.

Conclusion

In conclusion it can be said that, as far as our experiments are concerned, the advantages of using think-aloud protocols in both monologue and dialogue versions to investigate the translation process of FL learners and professional translators appear to outweigh potential drawbacks, as long as think-aloud protocols are elicited within a broader empirical research design that takes into account data obtained in a variety of ways and from several viewpoints, allowing for triangulation to be carried out.

Further, we consider that valuable insights can be obtained by means of comparisons made between verbal protocols obtained from different research subjects, with different language skill levels and different backgrounds in translation practice itself. In particular, the comparisons drawn between FL learners and professional translators seem to fulfil our hopes that it would be possible to acquire information that would help in the training of future translators.

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Name index

Subject index

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